NATIONAL
IN THE
WORLD WAR

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THE NATIONAL
IN THE
WORLD WAR

April 6, 1917—November 11, 1918

"*Let us have faith that right makes might; and in that faith let us, to the end, dare to do our duty as we understand it.*"

—*ABRAHAM LINCOLN.*

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To the National men who died on the field of battle;
To those who gave up their lives in camp, or in war service of any kind;
To the National women who went overseas as nurses;
To our soldiers, sailors, aviators and doctors;
To all of our Red Cross workers;
To the men and women of the Chemical Warfare Service;
To those who helped develop and produce the X-Ray and Vacuum Tubes;
To all who contributed, by research or special investigation, what they could towards the winning of the war;
To all who worked and gave money for War Relief;
To those who became "godparents" to French war-orphans and soldiers;
To those who made or sent special "comforts" for soldiers;
To our war gardeners;
To those who "bought bonds till it hurt," those who bought their quota of War Savings Stamps, and those who gave time and energy to the conducting of these campaigns;
To those who helped ferret out spies, sabotists, slackers and alien sympathizers;
To those who used their legal or accounting talents in war service;
To those who co-operated with the Fuel, Food and Railroad Administrations;
To all of those who responded so splendidly and unreservedly when called upon for War Service of any kind,

THIS VOLUME IS GRATEFULLY DEDICATED

H L Terry
B G Freeman

Copyright, 1920,
by
General Electric Company
(First Edition—June, 1920)

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PREFACE

"The shouting and the tumult cease—
The captains and the kings depart."
—*Kipling.*

The World War has passed into history.

While it lasted, and particularly during 1917 and 1918, when America was an active participant, it was the one subject uppermost in the minds of a hundred million Americans. The vast industrial army of this country became a part of the war machine, and the incandescent lamp industry, until the war was won, subordinated the making of lamps to the performance of its share as a unit in the industrial army.

In order to provide a permanent record of the part played by the National Lamp Works of General Electric Company, this volume has been compiled.

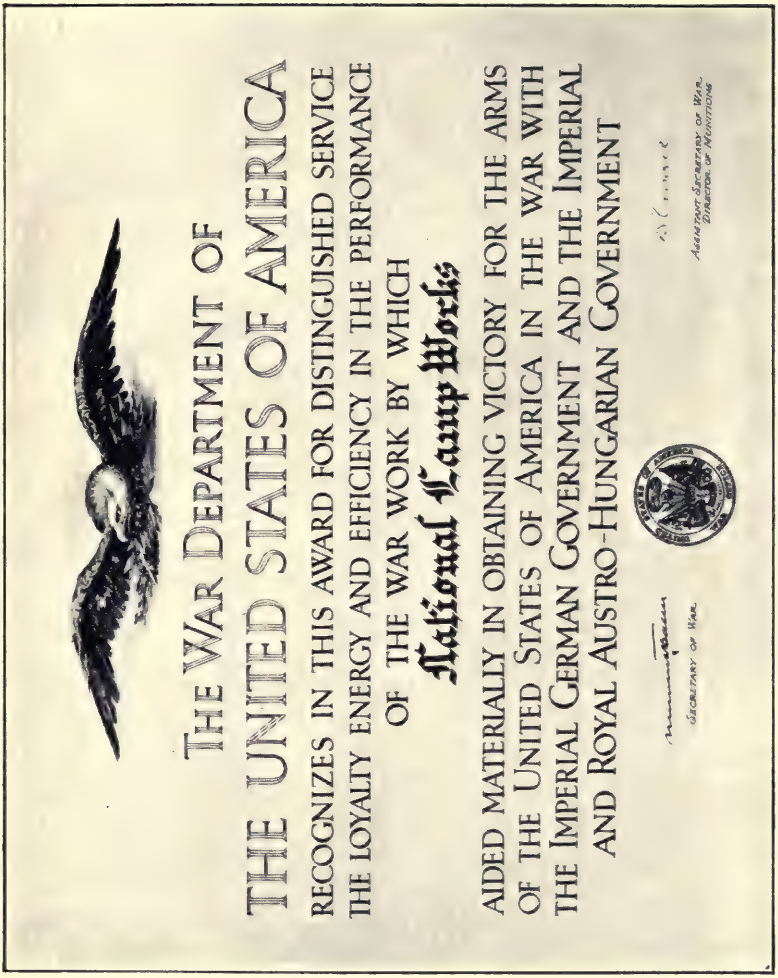
Every effort has been made to insure accuracy in the text, and yet it may be that, owing to the wide scope of the subject-matter, an occasional error in name or date or an occasional omission in giving credit where credit is due, will be found to exist. If such is the case, the errata have crept in despite the most painstaking efforts to detect and eliminate them. Some of our war-heroes have been exceedingly reticent, or diffident, about telling their stories for publication.

The record of war service along technical and developmental lines, contained in the following pages—such as the National's contribution to the development of the gas mask—would have been impossible without the extensive laboratories and capacious industrial organization centered at Nela Park. There were, of course, thousands of large, well-organized enterprises throughout the country, rendering quick and specialized aid in America's emergency. What the National did, was typical of such organizations, in general. If the National excelled in any one respect, it was, perhaps, in having taught its people to co-operate and harmonize their efforts.

No better statement of the value of this "pull-together" spirit can be given than is contained in the following paragraph from one of the war-letters issued by the Administration Department at Nela to all Departments and Divisions:

"The allies will win this war, but how soon they will win will depend upon the amount of effort which is put into winning and that, in turn, depends upon the effort of each one of us. We are likely to think of the small amount which each one can accomplish and forget the great force which results from combined effort."

May the same spirit of co-operation for the common good, which animated America in the world-struggle, be found in her homes and her industries forever!



THE WAR DEPARTMENT OF
THE UNITED STATES OF AMERICA
RECOGNIZES IN THIS AWARD FOR DISTINGUISHED SERVICE
THE LOYALTY ENERGY AND EFFICIENCY IN THE PERFORMANCE
OF THE WAR WORK BY WHICH
National Lamp Works
AIDED MATERIALLY IN OBTAINING VICTORY FOR THE ARMS
OF THE UNITED STATES OF AMERICA IN THE WAR WITH
THE IMPERIAL GERMAN GOVERNMENT AND THE IMPERIAL
AND ROYAL AUSTRO-HUNGARIAN GOVERNMENT

SECRETARY OF WAR

ASSISTANT SECRETARY OF WAR
DIRECTOR OF MUNITIONS

A Reduced Fac-simile of the Distinguished Service Award
Conferred Upon the National Lamp Works

697
NELA PARK

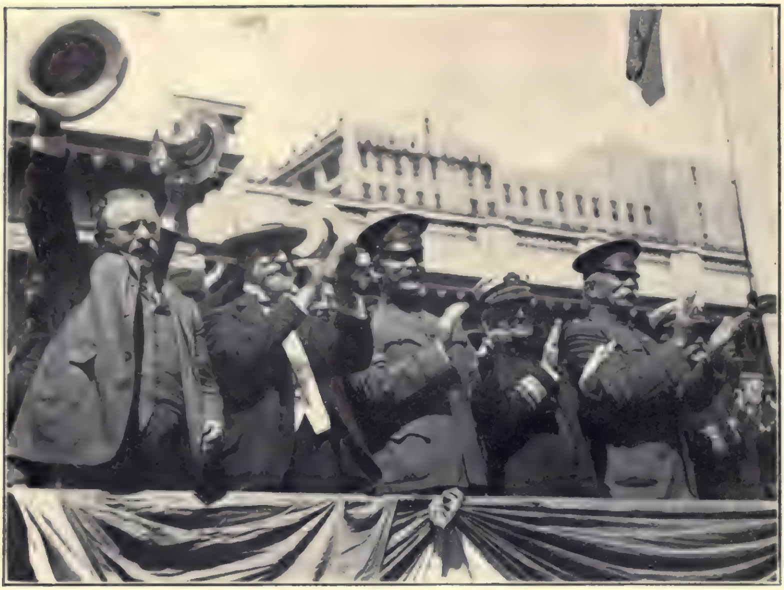
PART I

MILITARY SERVICE RECORDS

The story of the part played by employees of the National Lamp Works who were directly associated with the Military or Naval establishments of the United States or her allies during the World War.

The Parting of General Pershing and Marshal Foch

American Doughboy Band Playing Yankee Airs in Paris



Theodore Roosevelt   Chas. E. Hughes   Adjutant Gen. Sherrill
Rear Admiral Usher   General Hoyle   Admiral Gleaves

New York Bids Godspeed to the 71st Regiment

MILITARY SERVICE RECORDS

A PANORAMA OF THE NATIONAL'S MEN AND WOMEN IN SERVICE.

A complete history of the World War would have to do justice to the mightiest and most appalling efforts ever made by man in the organized destruction of life and property; it should also describe fully the unprecedented efforts at war-relief made by nurses, surgeons, and supporting organizations. No man, were he to live a million years, could write down every detail of heroism. We have here attempted merely to rough-sketch the part which the men and women of the National Lamp Works played in the gigantic struggle.

Our personal conceptions of the war vary. To some of us it took on a sordid aspect, for we personally participated in battles and skirmishes and were eyewitnesses of much that was revolting and brutal. To other of us, it was merely a period of conscientious endeavor, for we were far from the scenes of death and devastation. Yet even we were a part of the vast war-machine that made a victorious culmination possible, and to every one of us it was a time fluctuating with moments of intense anxiety, outbursting waves of patriotism and solemn obligation to duty.

The National's obligation was large, and in no finer way is the richness of her contribution manifested than in the fact that from her doors five hundred and ninety-seven men and women went out to offer themselves in the armed forces of the land, sea and air; in the service of the American Red Cross and in miscellaneous civilian branches of government war service.

According to our best information, four hundred and sixty-six National men were directly associated with the military establishment of the United States, while eight enlisted in the armies of our allies. The Navy and Naval Reserves drew eighty-three, the "devil-dog" Marines enlisted seven, while twenty-eight showed their preference for the "ethereal regions" by serving the air forces. To help fill the need which their country had for relief workers, five women enlisted in the ranks of the American Red Cross, all of them serving overseas. Mention should be made here, also, of those who enlisted in technical units of the army, doing experimental research and production work, such as was done in the Chemical Warfare Service (Development Division). The accomplishments of these men, together with a complete account of the various facilities placed at their disposal by the National organization, are separately treated in Part II, pages 167 to 227.

At home, too, was radiated the spirit of service, for those employees to whom was denied the privilege of serving directly in the military establishment, gave themselves readily and unselfishly to auxiliary work. The story of the relief work is told in Part III, pages 301 to 336 of this volume, while the National's activities in Liberty Loan drives and other fund-raising campaigns are related in Part IV, pages 339 to 364.

Figures are sometimes more interesting than words. It is pleasing to note that of the five hundred and ninety-seven National men and women in the service, fully 43% were detailed to overseas. The branches of the National which reported the largest number of men going overseas were the Ohio Division, Warren, Ohio, and the Engineering Department, Nela Park. Twenty-three men from Ohio Division sent in reports for this book, of whom fourteen, or 57%, had served overseas, one being in the American Army of Occupation. The Engineering Department, with thirty-three men reporting, had sixteen, or 48%, who had either been overseas or were stationed in foreign waters. Other divisions or departments which had several men across were the Niles Glass Works with twelve, the Lamp Equipment Division with eight and the Operating Department with eleven. Upon the signing of the armistice, twelve National boys marched with the Allied Armies of Occupation into Germany.

Twenty National Lads Make the Supreme Sacrifice

To the weary soldier the sound of taps means the close of a day well spent and the approach of a promising tomorrow. But for twenty National men in service, taps marked the approach of their last day on earth. Seven of these lads made the supreme sacrifice on the field of battle, three died from the effect of wounds, two met accidental death, while eight died from natural causes in the camp hospitals in this country or abroad. The National organization feels a solemn pride in the twenty gold stars in its service flag, for they were men who served their employers dependably in everyday life and their country faithfully in time of war. The list of those who gave their all while in the service follows. The service records of these men can be found by turning to the pages indicated.

1. John Stewart Allen, from wounds, October 12th, 1918. Returned Lamp Inspection Department. See page 25.
2. Enoch Edward Brooks, pneumonia, April 3rd, 1918, Camp Merritt, New Jersey. Niles Glass Division. Page 73.
3. George Charles Clancy, in action, October 9th, 1918. Euclid Glass Division. Page 76.
4. Robert Temple Coughlin, accidental, October 17th, 1917, Camp Sheridan. Cleveland Wire Division. Page 76.
5. James Wilbur Doll, pneumonia, November 10th, 1918, in France. Loudon Glass Division. Page 63.
6. Jesse Sales Gardner, bronchial pneumonia, October 7th, 1918. Ohio Division. Page 58.
7. Clarence Hammell, in action, September 26th, 1918. Oakland Mazda Lamp Division. Page 60.
8. Edward Franklin Hartman, influenza, October 12th, 1918, at Belmont Road Military Hospital, Liverpool, England. St. Louis Mazda Lamp Division. Page 94.
9. Datzel Frederick Hitchcock, accidental, December 7th, 1918, at sea. Engineering Department. Page 112.
10. Joseph Raymond Ingram, pneumonia, October 2nd, 1918. Camp Sherman. Loudon Glass Division. Page 100.
11. Francis Lee Judd, in French Hospital, December 17th, 1918. Oakland Mazda Lamp Division. Page 60.
12. Frank Joseph Kearney, in action, September 12th, 1918. Niles Glass Division. Page 71.
13. Noble Calvin Lintz, in action, July 21st, 1918. Detroit Miniature Lamp Division. Page 75.
14. Michael O'Donnell, in action, date unknown. Operating Department. Page 21.
15. Leslie Willard Parker, influenza, November 29th, 1918, at Cleveland Marine Hospital. Minnesota Mazda Lamp Division. Page 119.
16. Harry Edward Peffer, in action, July 14th, 1918. Niles Glass Division. Page 68.

17. James Edward Sullivan, pneumonia, October 9th, 1918, Camp Sherman. Niles Glass Division. Page 62.
18. Ray Leland Swartz, in action, September 29th, 1918. Ohio Division. Page 55.
19. Harmon Edward Whiteman, from wounds, November 8th, 1918. Niles Glass Division. Page 64.
20. William A. Wilcox, pneumonia, December, 1918. Euclid Glass Division. Page 77.

Another death which occurred among National's service men was that of Lewis Comiskey of the Ivanhoe-Regent Works. Although the end came after Mr. Comiskey was discharged from the army, we feel that since he had been out of military life such a short time mention should be made of him at this point. His service record will be found on page 52.

"Though love repine, and reason chafe,
There came a voice without reply,—
' 'Tis man's perdition to be safe
When for the truth he ought to die.' "

Battle Scarred Veterans The story of the National's heroes would not be complete without special mention of those who were wounded or gassed while exposed to enemy fire. More detailed information as to the degree of their injuries can be learned by referring to the pages indicated. This list would undoubtedly have been much longer had every man filed a complete record of his service.

1. Harry E. Baldauf, Euclid Glass Division. Page 60.
2. James Burns, Niles Glass Division. Page 73.
3. Joseph Cardinale, Providence Base Works. Page 81.
4. Fred Colcord, Oakland Mazda. Page 93.
5. Leroy C. Doane, Ivanhoe-Regent Works. Page 41.
6. Nicholas V. Duff, Returned Lamp Inspection Department. Page 24.
7. Roy H. Evans, Miniature Lamp Sales Department. Page 23.
8. Carmelo Fotte, Providence Base Works. Page 72.
9. Arthur D. Gibbs, Niles Glass Division. Page 71.
10. Fred S. Gregory, Ohio Division. Page 56.
11. Roger F. Hartman, Puritan Refilled Lamp Division. Page 86.
12. George B. Hayman, Cleveland Miniature Lamp Division. Page 59.

13. William G. Hilling, Cleveland Wire Division. Page 73.
14. Herbert C. Masonbrink, Lamp Equipment Division. Page 74.
15. Joseph S. Merrick, Loudon Glass Division. Page 69.
16. George M. Nibeck, Euclid Glass Division. Page 61.
17. William McLure Rosborough, Shelby Lamp Division. Page 47.
18. William Ross, Credit Department. Page 27.
19. T. Harold Sankey, Operating Department. Page 21.
20. Francis J. Savage, Nela Press. Page 27.
21. David Stambler, Puritan Refilled Lamp Division. Page 55.
22. William F. Steinhurst, Loudon Glass Division. Page 69.
23. Frank C. Williams, Youngstown Mazda Lamp Division. Page 99.

There were among National's service men four on whose breasts were pinned medals awarded by the United States Government, or the governments of our allies, for heroism on the field of battle or exceptional services rendered in industry during the Great War. These four include Nicholas V. Duff of the Returned Lamp Inspection Department (see page 24), who was awarded the French Distinguished Service Medal for bravery in the Argonne drive; David Stambler of the Puritan Refilled Division (mentioned further on page 55), the Croix de Guerre for meritorious service at Chateau-Thierry; Horace W. Beck, Jr. of the Columbia Lamp Division, whose service record will be found on page 54, the Croix de Guerre, and Colonel F. M. Dorsey of the Lamp Development Laboratory, the Distinguished Service Cross for work done as Chief of the Development Division of the Chemical Warfare Service. Besides these men Walter Sturrock of the Engineering Department, referred to on page 126, was cited by General Pershing for "exceptionally meritorious and conspicuous services."

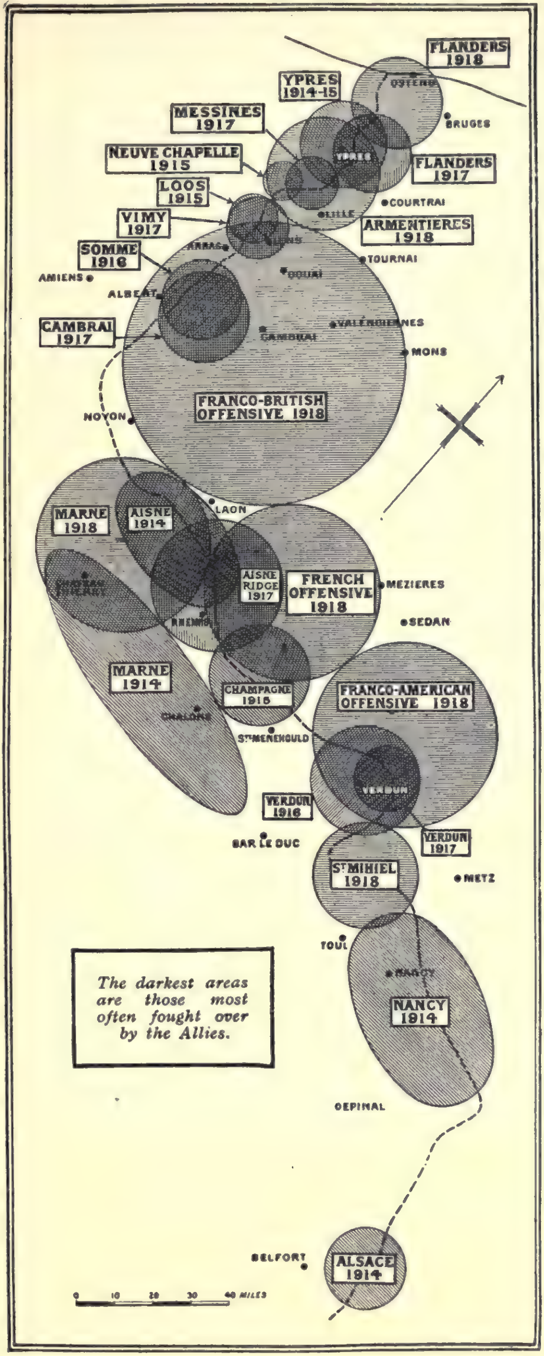
Service in Many Climes

In fulfilling their duties "National" men saw service in many different countries and territories. From within the borders of their own land they went to serve in the trenches along the frontiers of France, in ravished Belgium, along the shores of the Mediterranean and in the hills of sunny Italy. Some traveled among the foothills of the snow-peaked Alps, others journeyed to little Serbia or crossed the Pacific to the balmy islands of Hawaii. Many did duty in the North Sea, while in the Dardanelles, too, were National representatives. Six listed themselves in the Canadian Army and served with the daring which was characteristic of that splendid body. One served with the British, while one allied himself with the plucky Serbians against the common foe.

In going over the data available for this volume it was found that the National was represented in thirty-six American Army Divisions, and in the American Lafayette Escadrille (aviation). Among the overseas combatant divisions which contained lads from the National Lamp Works were the 1st, 2nd, 3rd, 4th, 5th, 6th, 26th, 27th, 28th, 29th, 30th, 31st, 32nd, 33rd, 35th, 37th, 42nd, 77th, 78th, 79th, 81st, 82nd, 84th, 86th, 87th, 88th, 89th, and 91st. The overseas depot divisions, 41st, 76th and 83rd, were well represented, as were also the 11th, 12th, 14th, 16th, and 20th divisions, which were in training in the United States when the armistice was signed.

Several of the above mentioned overseas combatant divisions were particularly active, the 1st taking part in the Montdidier-Noyon defensive and the offensives of Aisne-Marne, St. Mihiel and Meuse-Argonne; the 2nd Division participated in the same three offensives and in the defense of Aisne. The 26th took a prominent part in the three major drives just mentioned; the 28th Division, besides being instrumental in the defense of Aisne was active at Aisne-Marne, Oise-Aisne and Meuse-Argonne, while the 37th Division, which contained more National men than any other army division, aided in the offensives of Meuse-Argonne, Ypres-Lys and St. Mihiel. The deeds of the other divisions are just as worthy of note, for it cannot be said that the men of any one division were more capable or more deserving of praise than the lads of any other. All played the part allotted to them nobly and had the opportunity presented itself the Yanks who never aimed a rifle at a Hun would have rendered an account just as brilliant as did those who were marched to the front lines.

In narrating the experiences of National men we have deemed it advisable to separate the Army, Navy and Air Forces. Under each of these headings the National is taken up by the following sections:


FLANDERS 1918
OSTEND
YPRES 1914-15
MESSINES 1917
BRUGES
NEUVE CHAPELLE 1915
YPRES
FLANDERS 1917
LOOS 1915
COURTRAI
LILLE
VIMY 1917
ARMENTIERES 1918
ARRAS
LENS
SOMME 1916
TOURNAI
AMIENS
DOUAI
ALBERT
CAMBRAI 1917
VALENCIENNES
CAMBRAI
MONS
FRANCO-BRITISH OFFENSIVE 1918
NOYON
LAON
MARNE 1918
AISNE 1914
CHATEAU THIERRY
AISNE RIDGE 1917
FRENCH OFFENSIVE 1918
MEZIERES
SEDAN
REIMS
MARNE 1914
CHAMPAGNE 1915
FRANCO-AMERICAN OFFENSIVE 1918
CHALONS
ST MENEHOULD
VERDUN
VERDUN 1916
VERDUN 1917
BAR LE DUC
ST MIHIEL 1918
METZ
TOUL
NANCY
NANCY 1914
The darkest areas are those most often fought over by the Allies.
EPINAL
BELFORT
ALSACE 1914
0 10 20 30 40 MILES

PRINCIPAL

BATTLE AREAS

ON THE

WESTERN

FRONT

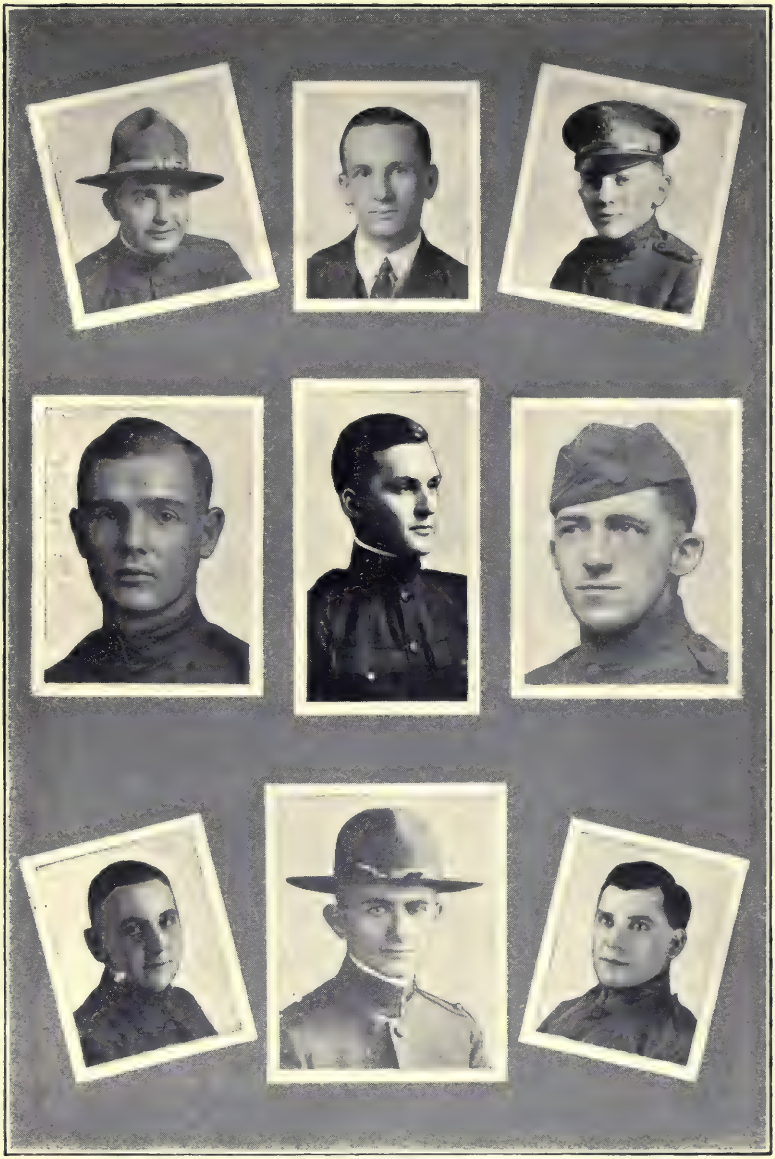
Published by Courtesy of The Independent

1. General Offices and Laboratories.
2. Sales Divisions.
3. Manufacturing Divisions.

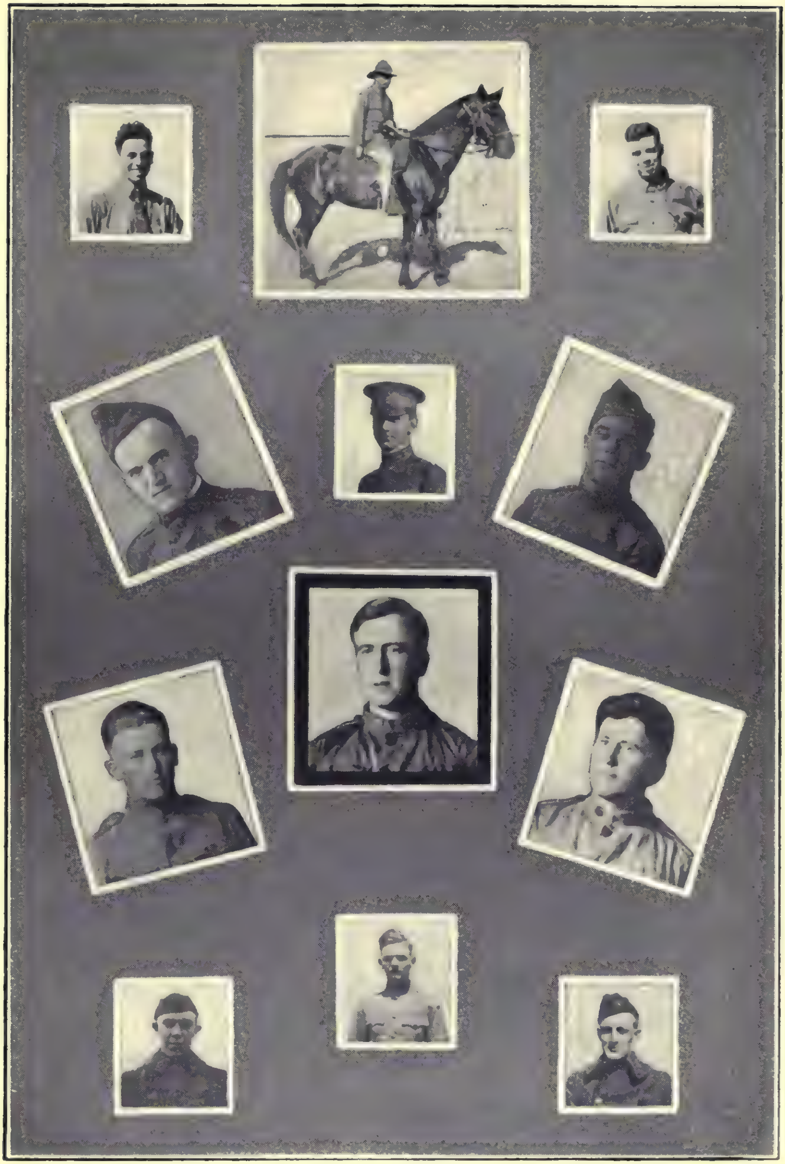
The purpose of the Military Service Chapter of this volume has been to describe the war service rendered by men and women *who were in the employ of the National Lamp Works at the time of entering service*. Information was solicited from these persons only. However, as a few men, who were not employed by the National organization until *after* their return to civilian life, voluntarily contributed the record of their experiences, we have been glad to interweave their stories among the rest.

One naturally wishes that every fellow in khaki, blue or kilts had engaged an expert photographer to accompany him in the service, so that we might be well supplied with photos, both personal and landscape. But as Uncle Sam's Army Rules decreed that all photographic paraphernalia should be left at home we are consequently made to suffer. Many men were fortunate enough to secure casual snapshots of themselves but in some cases these pictures were not clear enough to be reproduced in an engraving. This will account for the omission of a few of the prints which our friends were kind enough to submit for this volume.

Some of the photographs reproduced in this volume were, as will be noted by the captions, supplied by National Lamp men and women who were in service, or had relatives "over there." A majority of the remaining photographs of general interest are from Underwood and Underwood, New York.



W. Carroll Keenan	Horace M. Hitch	Wilbur M. Johnson
William Allsopp	Crawford G. Nixon	Frank J. Wishon
Myron J. Bechhold	George H. Smith	Cormine Dipietro



Carl C. Walker
John Komick
Herschel R. Gilbert
Roy H. Evans

Bradford Whiting
Charles C. Linerode
John S. Allen
Walter L. Warren

Charles E. Savage
Philip Cress
Louis B. Allen
Nicholas V. Duff

THE ARMY FORCES

GENERAL OFFICES AND LABORATORIES

THE INFANTRY

The Infantry asserted itself among the General Offices and Laboratories as the greatest employer of men. Approximately 19% of those entering service from this section of the National were in infantry regiments of the Regular or National Armies. Among these Robert F. Baker of the Engineering Department had a unique experience, for he informs us that he enlisted three times. We observe, however, that he was discharged but once. Bob's first duty was along the Mexican border in 1916, and when war broke out with Germany he re-enlisted as a private in the 145th Infantry of the 37th Division, stationed at Camp Sheridan. His overseas participation consisted of nine months' service, engaged in holding sectors at Baccarat, St. Mihiel and Avocourt and in the Meuse-Argonne and the two Ypres-Lys offensives. He was discharged May 8th, 1919, with the rank of first lieutenant.

The Operating Department was represented in the Infantry by several men, six of whom were across. Among them was W. Carroll Keenan, a member of Company C of the 331st Infantry, 83rd Division, which trained at Camp Sherman. "Cal" was overseas for eight months, stationed at Le Havre, Montargis, La Suze, Noyon, Chemire, Bourdons, Le Mans, Brest and several other places. He was discharged February 8th, 1919, and returned to Nela. Walter R. Mattern was also with the 331st Regiment and had a similar service record, while T. Harold Sankey was drafted October 2nd, 1917, and sent to Camp Sherman. He was assigned to Company M of the 23rd Infantry and later transferred to Camp Pike, Arkansas. Sankey arrived in France July 7th and on October 2nd, while participating in the action along the Champagne Front, between Rheims and Verdun, fell into a shell-hole and suffered injuries to his back and left knee. Upon discharge from service, Sankey returned to the Operating Department.

Among those making the supreme sacrifice was Michael O'Donnell, who was employed by the Operating Department as a laborer. He was inducted September 18th, 1917, and assigned to Company K, 331st Infantry. After training at Camp Sherman he was sent overseas in December, 1917. We were unable to learn the details of his death, except that he died a soldier and a hero on the field of battle.

Brothers From Blighty Laurence Rossington of the Publicity Department, hailing originally from Blighty, couldn't resist the call from across the Lake, and on August 26, 1916, joined the 241st Battalion of the Canadian Scottish Borderers. He was later transferred to the 48th Highlanders. Laurence's army training was received at Windsor, Ontario, Canada, and West Sandling and Witley, England. He also saw service in France but, being sworn to secrecy by the Canadian Government, he refused to discuss any of his personal experiences. Rossington upon receiving his discharge July 11th, 1919, was employed by the Engineering Department.

Laurence's brother Wallace, of the Large Lamp Sales Department, who termed himself the "Pocket Hercules" with his 106 pounds avoirdupois, enlisted May 21st, 1917, in the 4th Divisional Signal Company of the Canadian Army and was transferred to the 2nd Eastern Ontario Infantry Regiment, and still later to the Royal Canadian Engineers. Wallace was more talkative than his brother, and told the following story on himself. Going on sick call one day, he was asked by the medical officer, who Wallace admits was a fine veterinary surgeon, what his physical trouble was. Upon getting this information, the officer exclaimed, "But, my man, if you had this trivial ailment in civil life you wouldn't come to me, would you?" to which Rossington said he replied indignantly, "No, sir! I'd go to a real doctor!"

Rossington ranked as regimental sergeant major and was discharged March 31st, 1919.

William Allsopp of the Equipment Development Department, a Blighty by birth, a wood pattern maker by trade, and an infantryman by selective service, was inducted May 24th, 1918 and assigned to Company A, 1st Infantry Replacement Regiment at Camp Gordon but was later transferred to Camp Sherman. He was discharged January 22nd, 1919, ranking as sergeant. George E. Hathaway of the Nela Research Laboratory was inducted November 12th, 1917, and ordered to Camp Sherman. He was placed on the roster of

Company C of the 331st Infantry. George was afterwards transferred to Fort Leavenworth and from there to Camp Meade, meanwhile being assigned to a signal officers' training school where he ranked as sergeant.

"Zero Hour"— Evans Describes It.

On the list of those wounded in action was Roy H. Evans of the Miniature Lamp Sales Department. Entering service May 25th, 1918, he was sent to Camp Gordon where he was assigned to the 9th Company of the 1st Replacement Regiment. He trained there until July 15th when his outfit was transferred to Camp Merritt and prepared for overseas. Seven days later his regiment embarked for France, sailing on the English steamer Carmania, with a convoy of twenty-four ships. The Carmania docked at Liverpool, England, on August 3rd and August 9th, under cover of darkness, the regiment was transported to Le Havre, France. An eight-mile hike brought them to Camp Sinvic, where they remained overnight. The following day the men were loaded on those long-to-be-remembered French cars marked 8 CHEVAUX ET 40 HOMMES (8 horses and 40 men). After travelling three days and three nights, the boys arrived at St. Aignan, where a large classification camp was located. At this camp the 1st Replacement Regiment was divided, Roy being transferred to Company A of the 39th Regiment, 4th Division. On September 26th, 1918, after many weeks of instruction in throwing bombs and hand-grenades and in bayonet and gas drill he had his first taste of trench life in the Argonne Forest. The following day he went over the top, and on the 29th he was wounded in the left thigh by a machine-gun bullet. Due to bad roads and heavy traffic, it was eighteen hours before he reached an evacuation hospital. After three days in Base Hospital No. 53, twenty days in Base Hospital No 20 at Chatel-Guyon, and in hospitals at Savaney, he was declared unfit for further service, due to "drop foot," and was returned to the United States. On December 16th he landed at Newport News, Virginia, and was discharged from service at Columbus Barracks, Columbus, Ohio, February 3rd, 1919. Evans describes a Yank onslaught in the following words:

"The noise and the fury reached its crescendo, or most deafening climax, in the last few minutes before the 'zero hour.'

Zero hour was 5:30 A. M., and we had been instructed that at this time we were to go over the top. At five o'clock the first faint signs of dawn began creeping through the mist and fog that hung low over the ground, and at 5:15 we were ordered to stand to. We lined up in the trench, made the straps on our light packs more secure, adjusted our equipment, pulled in our belts a couple of notches and waited for the zero hour. This is the period of most painful expectancy, and many anxious eyes followed the minute hands on illuminated watches. The noise sounded as if the gates of hell had opened up. At last, 5:30! — the zero hour had come. At a given command we all scrambled up and out and over the top, yelling like madmen. Forward we went—it was a sight to carry with you to the grave—swarming like a multitude of bees from a great hive. Out and on and over the top we went."

Continuing, he says:

"We kept pushing ahead for the next two days over hills, through wee small towns and through woods and ravines. Day and night long lines of prisoners and of stretcher bearers carrying wounded filed to the rear. Airplanes fought overhead and crashed to earth. Observation balloons came down in flames. Machine-guns spit and artillery roared. At times we literally had to hack our way through the jungle of woods growths. At times it was like playing hide and seek, as very few Jerries could be seen. They were like will-o'-the-wisps, here, there and everywhere, concealed in underground dugouts and trees, always with an eye on you—but you couldn't see them."

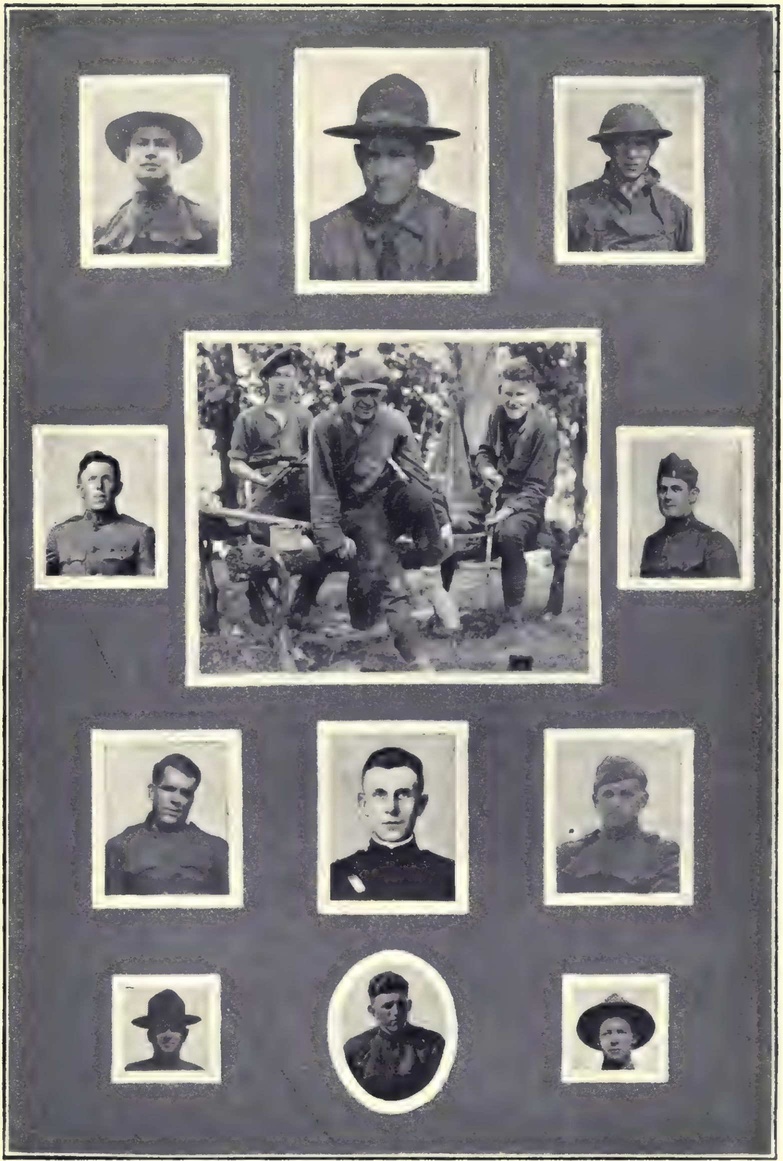
France Awards D. S. Medal to Duff

Among the wounded and medal wearers was Nicholas V. Duff of the Returned Lamp Inspection Department. Inducted May 24th, 1918, assigned to the 59th Infantry of the 4th Division, securing his preliminary training at Camps Gordon and Merritt, Duff was sent overseas where he took part in the action at Chateau-Thierry, St. Mihiel and in the Argonne. In the Argonne drive he was wounded in the right leg by shrapnel, but recovered sufficiently to resume his place with the regiment. Late in September he was again overtaken by misfortune, this time being so severely wounded by machine-gun fire that the vision of his right eye was affected. We are happy to record, however, that his services did not go un-

Upper Photo—Nela Operating Building.

Middle Photo—Administration Building.

Lower Photo—Sales Building.



John A. Walsh Theodore S. Jewell Altamont S. Barker

Laurence Rossington Wallace Rossington William Ross
Thomas J. Cunningham Robt. F. Baker

George F. Smith Charles L. Holm Herbert W. Ellis

Thomas L. Weir George E. Hathaway Lincoln J. Tefft rewarded, for Duff was given the French Distinguished Service Medal for his valorous deeds in the Argonne.

Louis B. Allen and John Stewart Allen, twin brothers, were born September 26th, 1893. On May 25th, 1918, both were inducted and sent to Camp Gordon, where Louis was attached to Company I of the 28th Infantry, 1st Division, and John to the 29th Company of the 3rd Infantry Replacement Regiment, and later to Company M, the 18th Infantry, 1st Division. On September 25th, 1919, Louis was discharged from the Army at Camp Meade; but John lies where he fought and died —in France.

Embarking for overseas July 22nd, 1918, Louis Allen of the Operating Department landed in Cherbourg, France. His part was taken in the defense of Saizerais sector, the St. Mihiel offensive and the Meuse-Argonne drive, October 1st to October 12th, 1918. On December 13th, 1918 Louis marched with the Army of Occupation into Germany and remained in that country until August 15th, 1919. He landed at Hoboken September 4th and was discharged at Camp Meade September 25th, 1919.

John Allen, who was employed as a lamp inspector by the Returned Lamp Inspection Department, went to France with the 1st Division. For a time he was located south of Toul and on August 4th, 1918, his Regiment was transferred to the Seizanes sector, subsequently moving to the Vaucouleurs area and Sevigny. From September 13th to September 16th he was in the St. Mihiel sector and proceeded from there to Bois-la-ville. It was in the Argonne drive, in which he took part from October 1st to October 11th, that Allen was wounded several times, and gassed. On October 12th, 1918, he died from the effect of these wounds. He was buried in the American Cemetery at Froides, Chateau-de-Salvange, France.

Harold C. Boulton of Company C, 329th Infantry, 83rd Division, saw overseas service with that body and was stationed in the training area of Yvre La Polin, France. Boulton narrated the following conversation as taking place between an American negro who had just arrived overseas, and a coal-black Algerian. The American darkey, having addressed the Algerian and receiving no reply, could not understand why the latter did not answer, and believing him to be a newly-arrived American soldier exclaimed pitifully, "Partner, you don't mean to say you-all done lost yo' speech already?"

Boulton upon returning from service was employed by the Glass Technology Department.

George F. Smith of the Chemical Laboratory was drafted September 3rd, 1918, into the 34th Company, 9th Training Battalion of the 158th Depot Brigade at Camp Sherman, but was later given an indefinite furlough to teach chemistry in the Student Army Training Corps at the University of Michigan. John Komick of the Operating Department renounced his allegiance to the German Emperor that he might fight for his adopted country. Komick was drafted October 3rd, 1917, and served at Camps Sherman and Lee. He was attached to the 25th Company, 7th Training Battalion, and later to the 9th Company, 3rd Battalion, being discharged December 31st, 1918.

Drafted September 7th, 1917, John L. Eddy of the Operating Department was sent to Camp Sherman and attached to a supply company of the 331st Infantry. He went overseas with the 83rd Division, sailing from Montreal, Canada, June 6th, 1918. Upon his arrival in France, Eddy was transferred to Company I of the 112th Infantry, 28th Division. He saw action at Thiaucourt, where he went over the top twice and brought back prisoners each time. After eleven months overseas he was ordered home, and was discharged May 17th, 1919.

Another infantryman was Edward du Bois Stryker, Jr., who enlisted in July, 1915, in the 7th New York National Guard. The 7th Regiment was later known as the 107th Infantry and Stryker was on its roster for three years. For a time he served along the Texas border and was then detailed to Camp Wadsworth, Spartanburg, South Carolina. Stryker was later employed by the Engineering Department.

Others in the Infantry were Ira Talbott of the Equipment Development Department, who was drafted September 3rd, 1918 and served three months in the 16th Company, 4th Training Battalion, 158th Depot Brigade at Camp Sherman; Carmine Dipietro of the Operating Department who was inducted July 24th, 1918, and attached to the 2nd Provincial Regiment, 156th Depot Brigade at Camp Jackson, South Carolina, and Fred C. Kathe who was transferred from the Student Army Training Corps detachment at Michigan Agricultural College to Company I, 2nd Battalion of the

Central Infantry Officers' Training School at Camp McArthur, Waco, Texas. He was in the service from October 2nd, 1918 to December 2nd, 1918. Upon being released Kathe was employed by the Lamp Development Laboratory.

Three Nela Press boys in the infantry were William E. Schroeder, Paul Catano and James F. Savage. Schroeder was drafted May 24th, 1918, and sent to Camp Gordon where he was with the 23rd Company of the 1st Replacement Regiment. Other camps at which he served were Upton, Merritt and Sherman. He was discharged as a private, 1st class, May 13th, 1919. Catano, who was employed by Nela Press as a press feeder, was in an infantry regiment but information concerning his army service is not available. Savage was drafted September 29th, 1917, and assigned to the 5th Training Battalion at Camp Sherman. He was transferred to the 348th Infantry, 87th Division, at Camp Pike but went overseas as a replacement. He eventually entered the ranks of Company A, 23rd Infantry, 2nd Division, and participated with that outfit in several actions. Besides being wounded in the heel by a machine-gun bullet while taking part in the Argonne Drive, Savage suffered the effects of a German gas attack.

ARTILLERY

Field Artillery.—Curiously enough, some men wanted to look into something bigger and more destructive than an Army Springfield and consequently enlisted in the various branches of the artillery. Among this number were five Nela boys who enlisted in the 135th Field Artillery, namely Altamont S. Barker of the Engineering Department, Fred I. Sheppard of Statistical, William Ross of Credit, Lincoln J. Tefft of Administration and Rudolph T. Bard of Nela Press.

Barker enlisted April 23rd, 1917, and was stationed at Camp Sheridan, Alabama. After landing in France he was in the following engagements:

Marbache sector, Lorraine, October 2nd to October 19th, 1918.

Troyon sector, St. Mihiel Front, October 20th to November 8th, 1918.

Thiaucourt, November 9th to November 11th, 1918.

Rudolph Bard enlisted April 12th, 1917, and was attached to Battery C. He attained the rank of sergeant and was in these actions:

Marbache sector, Lorraine, October 12th to October 23rd, 1918.

Troyon sector, St. Mihiel, October 28th to November 8th.

Thiaucourt sector, November 9th to November 11th.

Sheppard, Ross and Tefft were in Battery F, 135th Artillery, and participated in the same engagements as Barker and Bard. Ross was the only unfortunate man, being slightly wounded while under enemy fire in the Marbache sector near Pont-a-Mousson. All five were discharged from the Army April 11th, 1919, and returned to Nela.

Lieutenant Sidney Caswell, whose service record is to be found on page 42, commanded the firing battery to which Ross was attached. Concerning Ross, Caswell wrote:

"The night that Bill was wounded, our position near Pont-a-Mousson was being very heavily shelled by 210 m. m. guns. The Germans continued this shelling for seven hours, making the position quite uncomfortable.

"Ross was telephone operator in the telephone dugout. Very early in the evening our communication was cut off and Bill endeavored on several different occasions to re-establish communication under heavy shell fire. Later we had a direct hit on the telephone dugout, the shell getting about fifteen men, among them being Ross. We had to pull him out and I ordered him to the rear. In spite of the fact that he was very badly wounded and could hardly talk, he wished to stay at the position.

"On another occasion, when he was not in a fit condition, I visited him at the hospital and he begged me to take him back to the front, which of course was impossible at that time.

"Ross displayed unusual heroism during the entire time he was at the front."

Corwin T. Kirkpatrick enlisted May 28th, 1918, in the 4th Field Artillery Regiment and was located at Camp Shelby, Mississippi; Camp Logan, Texas; Fort Sill, Oklahoma, and with the American Expeditionary Forces from October 28th, 1918 to January 28th, 1919. Before going overseas he was transferred to the 83rd Regiment and while in France was a member of the Guard of Honor to President Wilson when the latter landed in Brest for the first time. On being discharged from the Army February 19th, 1919, Kirkpatrick was employed by the Equipment Development Department.

Inducted October 5th, 1917 as a private, Charles L. Holm of the Engineering Department, after eleven months' Army training, was promoted to second lieutenant of artillery. He reported at Camp Taylor, Kentucky, early in October, 1917, and was assigned to Company C of the 309th Field Signal Battalion. He was later transferred to Camp Jackson and after a period of training at that camp was detailed overseas. Holm arrived in France July 5th, 1918, and from July 10th to September 15th was at the Saumur Artillery School, where he was commissioned and assigned to the 312th Field Artillery.

Crawford G. Nixon of Standardizing Department, upon entering service July 8th, 1918, was attached to the 5th Company, 2nd Battalion, 154th Depot Brigade, at Camp Meade, Maryland. He had been on duty there but a short time, however, when he was transferred to the artillery station at Camp Taylor, Kentucky. At the time of his discharge from service Nixon had attained the rank of second lieutenant.

A TASK WITH A REAL "PUNCH" TO IT

Coast Artillery This branch was represented by Edward N. Horr of the Engineering Department, who enlisted as a second lieutenant, October 26th, 1917. He was detailed as an instructor in orientation and heavy artillery gunnery. Ed used to take keen delight in watching a brigadier-general and four colonels hit the "punch" in a dry state, but does not say whether he was always an onlooker or at times may have been the sixth member of the party. At any rate Horr took great pride in the fact that he was not discharged from the Army. He "resigned" January 10th, 1919, after attaining the rank of captain.

Heavy Artillery Ray B. Griffing enlisted July 17th, 1918, and was assigned to Battery E of the 38th Regiment. He trained at Fort Hamilton, Camp Stuart and Camp Wadsworth where he was promoted to sergeant. On November 11th, 1918, Ray was in mid-ocean on his way to France and was very disappointed that he could not at least have put foot on foreign soil. Upon his discharge from the Army, Griffing was employed by the Lamp Development Laboratory.

MACHINE-GUN

Enlisting February 21st, 1918, in the Western Ontario Reserves, Joseph A. Molloy of the Operating Department received his preliminary training at Queens Park, London, Canada. He was then sent to England where he secured additional intensive training at Bramshott and Seaford. On August 17th, 1918, he arrived in France. Meanwhile he had been transferred to the 3rd Canadian Machine-Gun Battalion, with which outfit he experienced all the thrills of his active service. On August 20th, Joe was marched to the front line and on the following day took part in the battle of Arras. Other engagements in which he saw action were the battles of Queant Drocourt, Bourlon Woods, Cambrai and Valenciennes. He returned to Nela upon being discharged from the Canadian Army March 29th, 1919.

ENGINEER CORPS

Carl C. Walker and Charles Elmer Savage, being connected with the Engineering Department at Nela, thought it sound logic to join the Engineers. Elmer's "hunch" was a very good one, as will appear presently. Enlisting April 30th, 1917, in the 112th Regiment of the 37th Division, he spent several months at Fort Sheridan, Illinois, and Camp Sheridan, Alabama; after which he went overseas, seeing action at Meuse-Argonne, St. Mihiel, Scheldt-Ypres, Ypres-Lys and in the Baccarat sector. Savage must have enjoyed his trip immensely, for his letters home always dealt with the humorous side of the life. For example, he gave us the following conversation overheard between two negroes. They were discussing the U. S. and U. S. N. A. buttons. Said the one, "What's the U. S. N. A. stand for anyway?" Retorted the other, "Say, Nigger, you mus' be ignorant. That means Uncle Sam's Nigger Army." Savage was discharged April 16th, 1919.

Carl Walker entered service May 11th, 1917, with Company B of the 112th Engineers and trained at Fort Sheridan, Illinois; Camp Sheridan, Alabama, and Camp Lee, Virginia. He was discharged February 12th, 1919, being at that date with the Central Records Office of General Headquarters.

Monroe J. Fried of Nela Press also enlisted in the 112th Engineers and was assigned to Company B. His training was received at Camp Willis, Ohio; Fort Sheridan, Illinois;

The First American Flag to fly over a German Fort across the Rhine
Fort Ehrenbreitstein

(Photograph furnished by Lieut. Wilber Johnson)

There were Play Hours as Well as Work Hours

U. S. Mail for the Army of Occupation arriving at
Coblenz, Germany, in U. S. Mail Cars

(Photograph furnished by Lieut. Wilber Johnson)

Doughboys of the 1st Division cross the Moselle River
into Germany

Camp Sheridan, Alabama, and Camp Lee, Virginia. Fried had the distinction of being one of the first National men to enlist, entering service June 29th, 1916, at the age of forty-three years. He was discharged April 19th, 1919.

Frank J. Wishon, an Operating Department patriot, enlisted February 13th, 1918, and was assigned to Company B of the 37th Regiment of Engineers which trained at Fort Myer, Virginia. Overseas, this regiment operated with the 1st Army and took part in the following actions:

Aisne-Marne offensive, July 26th to August 6th, 1918.
St. Mihiel offensive, September 12th to September 16th.
Meuse-Argonne offensive, September 26th to November 11th.

Before coming back to us again, Wishon had the pleasure of crossing the Rhine with the Army of Occupation. He was in Germany from November 26th, 1918 to January 9th, 1919. Part of this period was spent in Coblenz.

SIGNAL CORPS

Wilber M. Johnson, a cinematographic engineer with the Engineering Department, enlisted August 27th, 1917, in the Second Officers' Training School at Fort Benjamin Harrison, Indiana, where upon completion of his course he was commissioned a second lieutenant in the Signal Corps. He was then assigned to the 308th Field Signal Battalion of the 83rd Division at Camp Sherman. Upon arriving overseas this battalion operated with the Third Army Corps and Wilber was detailed as radio officer. It was his duty to keep open the lines of communication between the field and general headquarters, and in this capacity he participated in the offensives of Aisne-Marne, Oise-Aisne and Meuse-Argonne. From December 14th, 1918 to July 9th, 1919, Johnson was with the American Army of Occupation. Incidentally, he celebrated the Fourth of July in Berlin.

Sergeant, 1st class, Herbert W. Ellis, an electrical engineer of the Engineering Department, was inducted January 23rd, 1918. He was ordered to Fort Leavenworth, Kansas, and assigned to Company G of the Second Depot Battalion. Ellis had one year's service in France, being located in Tours where he was doing equipment engineering work in the Telephone and Telegraph Division of the Office of the

Chief Signal Officer of the American Expeditionary Forces. He returned to the United States in June and was discharged July 3rd, 1919.

AMMUNITION TRAIN

The only Nela man attached to this service was Walter L. Warren of the Engineering Department. Inducted March 29th, 1918, he was sent to Camp Sherman and assigned to Company F of the 308th Ammunition Train, 83rd Division. A few months later Walter sailed for France, where he saw action with the 32nd Division at:

West Meuse, September 26th to October 2nd, 1918.
Bois de la Grande Montaigne, October 4th to October 30th.
East Meuse, November 9th to November 11th.

The 308th Regiment also operated for a short time with the 29th, 89th and 91st Divisions, but saw no action while working with these divisions.

MOTOR TRANSPORT CORPS

Not all of the active military work was done overseas and it remained for a few Nela men to carry on their indispensable part in this country with Motor Transport units. Myron J. Bechhold of the Operating Department was inducted September 3rd, 1918, and sent to Camp Sherman. After a short stay with the 30th Company, 8th Training Battalion, 158th Depot Brigade, he was transferred to a transport unit at Camp Jessup, Georgia. Rudolph L. Nusker was also located at Camp Jessup, having been transferred from the Student Army Training Corps detachment at Toledo University. Upon being discharged from service April 5th, 1919, he was employed by the Equipment Development Department. Henry Herrman of the Credit Department was the other Nela man in the motor transport service. He enlisted June 15th, 1918, and was discharged January 1st, 1919.

CHEMICAL WARFARE SERVICE

One of the important branches of the service which men from the General Offices of the National entered was the Chemical Warfare Service. Their work here was extremely essential and required unceasing effort.

The pages of Part II (Chemical Warfare Service) are evidence of the sterling war record of Colonel Frank M.

Dorsey. At the time he was loaned to the government by the National Lamp Works, Mr. Dorsey was Chemical Engineer of the Lamp Development Laboratory. He was chosen by the government as one of the men best fitted for the task of perfecting materials needed in the manufacture of gas masks. He played his part well because he possessed, to quote a staff officer who worked side by side with Colonel Dorsey, "technical ability, courage and tremendous driving energy." Colonel Dorsey eventually became Chief of the Development Division of the Chemical Warfare Service.

The first month of the United States' participation in the war, Mr. Dorsey's principal interest was concentrated on the then serious problem of developing a satisfactory absorbent for the gas mask. By November, 1918, however, his duties as Chief not only consisted of the supervision of the work at the Defense Section of the Development Division at Nela Park but also placed him in charge of the manufacturing development division of the American University, and the development work at Midland, Michigan, at Hastings-on-Hudson and at the 131st street Laboratory, Cleveland. He was also acting as technical advisor for the defense work at Astoria, Long Island.

J. Fred Donovan, manager of the Equipment Development Department, concerning whom more detailed information is to be found on page 226, received a captaincy in the Development Division of the Chemical Warfare Service in October, 1918. His commission was the merited reward for the valuable service he had rendered the Government for many months as a civilian worker.

On August 10th, 1918, Mr. J. Roy Duff, manager of the Chief Accounting Department, severed his connection with the National Lamp Works that he might accept a commission as captain in the Chemical Warfare Service. Further reference to Mr. Duff's service may be found on page 186.

Edwin J. Haefeli, a glass worker with the Lamp Development Laboratory, was inducted as a government civilian employe August 24th, 1917, and assigned to the Gas Defense Division. In September, 1917, while stationed at the government arsenal at Astoria, Long Island, N. Y., he performed a very commendable bit of work. Seeing the dire need for chemical apparatus at that plant, he voluntarily worked three days and three nights without sleep until he had produced the equipment needed to test material used in gas masks. On December 8th, 1917, he was transferred to Cleveland, where he supervised the work of installing glass-working equipment in the Gas Defense Laboratory at Nela Park. He was released from government service February 17th, 1919.

Ralph B. Thomas was drafted October 3rd, 1917, and assigned to Company G of the 353rd Infantry, 89th Division, at Camp Funston, Kansas, but was soon transferred to the Development Division of the Chemical Warfare Service. He was connected with the Cleveland branch of the Edgewood Arsenal and later with the Development Division Laboratory at Willoughby, Ohio. Upon being discharged February 5th, 1919, he was employed by the Lamp Development Laboratory. Marvin Pipkin took a position with the same Department upon returning from service. He had enlisted in Jacksonville, Florida, November 5th, 1917, in the Gas Defense Department, as a private. He was posted at the Laboratories at Nela Park for some time, where he attained the rank of master engineer, senior grade.

Upon being discharged from the Chemical Warfare Service, May 23rd, 1918, George E. Inman took employment with the Lamp Development Laboratory.

Conrad Peterson enlisted in the Ordnance Department but was transferred to the Chemical Warfare Service, Cleveland. He was located at the Defense Laboratory, East 131st and Taft Ave., at the Nela Park Defense Laboratory, and later the Development Division, Willoughby. He was employed by the Lamp Development Laboratory upon being discharged from service.

Joseph A. Welton of the Glass Technology Department was drafted September 5th, 1918, and sent to the Syracuse Recruit Camp where he was assigned to the 102nd Company, 25th Battalion. He was later transferred to a casual company at the Edgewood Arsenal, Edgewood, Maryland, where he was posted until discharged from service December 27th, 1918. Herbert J. Morgenstern of Standardizing Department was inducted September 4th, 1918. After serving in the depot brigade at Camp Sherman for a few weeks he was transferred to the Chemical Warfare Service. Elmer H. Beckman of the Chemical Laboratory, in the performance of his duties as chemist, became thoroughly convinced that all the fighting was not done in the trenches, for he found his work to be arduous and not always free from danger.

Dale C. Hughes of the Lamp Development Laboratory was engaged from May 1st, 1917 to June 18th, 1918, as a civilian worker in the development of gas masks and was located in the chemical laboratories at Nela Park. On June 18th, 1918, he received a commission as first lieutenant in the Sanitary Corps, but being familiar with Chemical Warfare problems was transferred to the Gas Defense Division of the Chemical Warfare Service. Dale was ordered to the Astoria Cantonment at Astoria, Long Island, where he was located until discharged from the service February 21st, 1919. Upon returning to the National he became Secretary of the Manufacturing Committee.

Others in this service were Glen F. Boruff, Walker J. King and Kenneth G. Reider. Boruff was located at Fort Oglethorpe, Georgia, and later at the Astoria Arsenal, Long Island. He was employed by the Lamp Development Laboratory upon being discharged February 24th, 1919. King was stationed at the American University, Washington, D. C., being discharged April 16th, 1919; later accepting a position with the Chemical Laboratory. Kenneth Reider of the Glass Technology Department enlisted May 25th, 1918, in the Medical Corps but after some time at Camp Greenleaf, Georgia, was transferred to the Chemical Warfare Service and located at the Edgewood Arsenal Laboratory, Cleveland, and later at the Development Division Laboratory at Willoughby, Ohio. He was discharged December 19th, 1918, ranking as sergeant.

ORDNANCE DEPARTMENT

Many men were connected with the Ordnance Department at Washington, D. C. and at various camps. George H. Smith of the Engineering Department was inducted January 16th, 1918, and assigned for active duty at the United States Arsenal at San Antonio, Texas. George also saw service in the office of the Chief of Ordnance, Washington, D. C. and at the Proving Grounds, Aberdeen, Maryland. He attained the rank of second lieutenant.

Charles C. Linerode of the Auditing Department enlisted January 25th, 1918, in the Supply Division of the Ordnance

Department and was commissioned a second lieutenant. Charley informs us that his most interesting experiences were "getting into the service, and being discharged."

Thomas L. Wier of the Operating Department was detailed with an ordnance supply squadron which outfitted divisions for overseas duty. He enlisted July 1st, 1918, and was stationed at Camps Gordon, Georgia; Sheridan, Alabama; Raritan, New Jersey, and Sherman, Ohio. Tom was discharged March 1st, 1919. Horace M. Hitch of Statistical Department was in the Cost Accounting Branch from September 17th, 1917 to June 25th, 1919, while Leslie P. Tyler was in the Ordnance Machine-Gun School at Camp Hancock, Georgia, and later the Light Mobile Repair Section. He was honorably discharged March 30th, 1919, and entered the employ of the Equipment Development Department.

Irving H. Gerlach of Bulb and Tubing Department enlisted in the Ordnance Department of the Army in August, 1917, as a Cost Accountant. In 1918, he was promoted to the position of Accountant in Charge of the Government work at the Symington Bros. Machine Corporation, of Rochester, N. Y., which position he held until the first of 1919, when he was made Assistant Supervisor of the Rochester district comprising the entire state of New York, excepting New York City. He held this latter position until March of 1919, when he was honorably discharged.

Thomas J. Kavanagh was honorably discharged September 15th, 1919 from the Ordnance Department, Washington, D. C., with the rank of first lieutenant, and employed by Equipment Development Department.

MEDICAL CORPS

Only three men from Nela Park, Dr. Percy W. Cobb, Leroy F. Price and George D. Sligen, were in medical units. Dr. Cobb, a physiologist with Nela Research Laboratory, was commissioned a captain in the Medical Corps April 17th, 1918, and reported at Camp Hancock, Georgia, where he was on duty until July 13th, 1918. He was then detailed to the Medical Research Laboratory, Hazelhurst Field, Mineola, Long Island. At the date our volume went to press Dr. Cobb was located at Mitchell Field, Garden City, Long Island.

LeRoy F. Price, who was in charge of photometry work in the Engineering Department, was inducted September

5th, 1918. He was assigned to the Medical Corps and spent his entire army period at Camp Greenleaf, Georgia, with the 7th Battalion.

George D. Sligen of the Auditing Department was with a medical supply detachment and spent considerable time at Debarkation Hospital Number 51 at Hampton, Virginia. He was also detailed during his Army career at Camp Zachary Taylor, Kentucky and Camp Stuart, Virginia.

AMBULANCE UNITS

John A. Walsh of Equipment Development Department enlisted August 16th, 1917, in Section 548 of the Ambulance Service and was ordered to report at Camp Crane, Allentown, Pennsylvania. He was later transferred to the Ordnance Department and assigned to Camp Hancock, Georgia. He left the United States August 14th, 1918, as Sergeant, Third Heavy Mobile Ordnance Repair Shop. He arrived at Brest, France, August 26th and proceeded to Libourne, Gironde, the heavy artillery training center. On October 28th, Walsh was assigned to the First Army Artillery. The signing of the armistice prevented his reaching the front lines. He sailed from Bordeaux, France, April 24th, 1919, arriving in New York May 6th. On May 23rd, he was discharged at Camp Sherman, and on June 2nd, received a belated commission as second lieutenant of Ordnance.

William J. Kavanaugh of the Engineering Department entered Packard Ambulance Unit 55, June 16th, 1917, and was located at Camp Persons, Allentown.

S. A. T. C.

Eleven boys were affiliated with the Army through the Student Army Training Corps. They were:

1. Lowell M. Keister, Jr., Realty Department; Carnegie Institute of Technology, Pittsburg, Pennsylvania.
2. Coursen W. Sponsler, Bulb and Tubing Department; Ohio Wesleyan University, Delaware, Ohio.
3. Gunner B. Nystrom, later of Equipment Development Department, Baldwin-Wallace College, Berea, Ohio.
4. Wayne G. Henderson, Chemical Laboratory; Case School of Applied Science, Cleveland, Ohio.

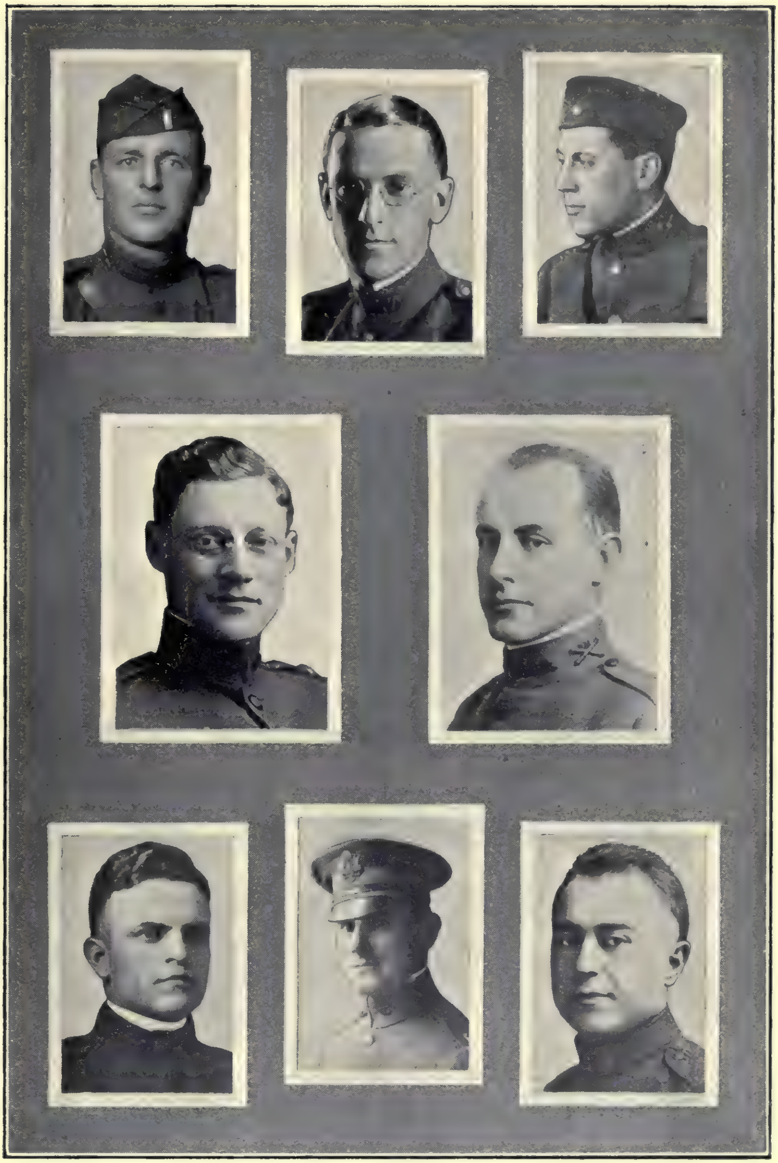
5. Gerald H. Coleman, later of the Chemical Laboratory; Ohio State University, Columbus, Ohio.
6. John Belford, Engineering Department; University of Pittsburg, Pittsburg, Pennsylvania.
7. Donald Burdette, Engineering Department; Case School of Applied Science, Cleveland, Ohio.
8. Jos. Glasser, Engineering Department; Kenyon College, Gambier, Ohio.
9. John Rice, Engineering Department; St. Ignatius College, Cleveland, Ohio.
10. Ralph Curth, Nela Research Laboratory; Ohio State University, Columbus, Ohio.
11. Erwin E. Lehmann, Standardizing Department; Case School of Applied Science, Cleveland, Ohio.

OTHER GENERAL OFFICE AND LABORATORY MEN IN SERVICE

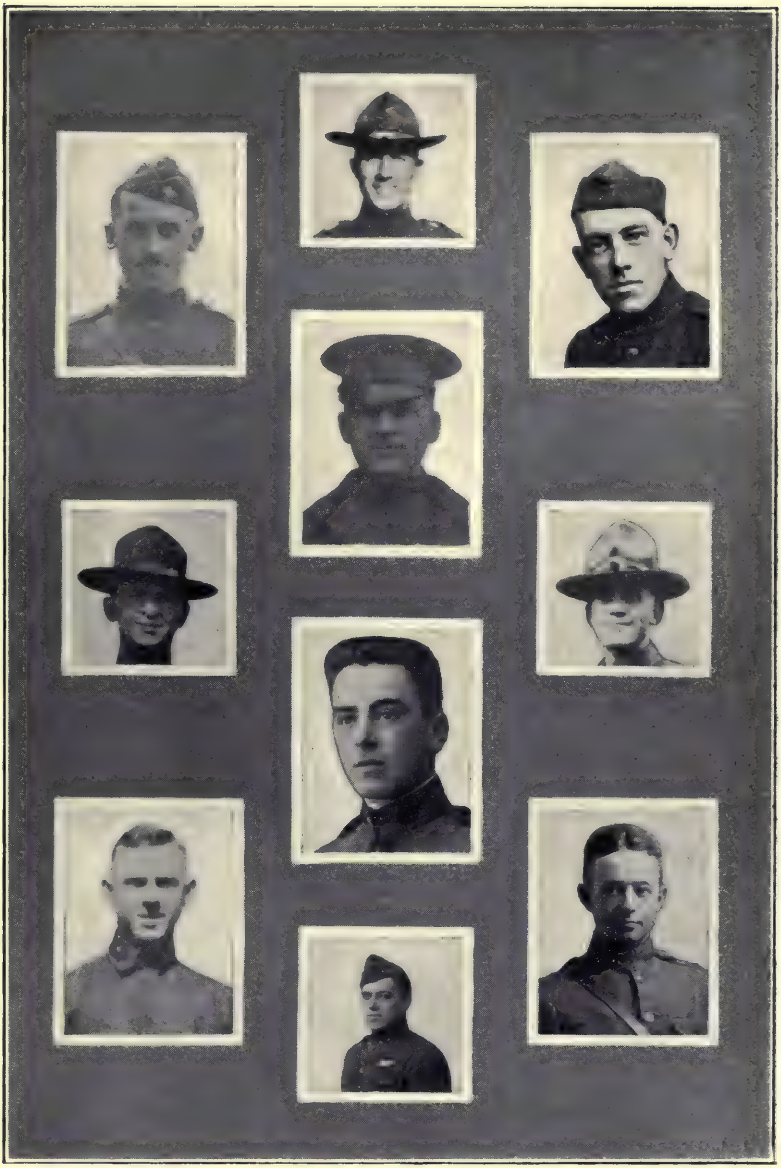
Theodore S. Jewell of the Operating Department and Charles D. Spencer, who was later employed by the Glass Technology Department, were both in the service of the Quartermaster Corps. Jewell was located at Camp Sherman until discharged October 20th, 1918, while Spencer served at Camps Jackson and Sevier, being discharged January 31st, 1919.

Lamp Inspector Bradford Whiting of the Returned Lamp Inspection Department, upon entering service became a fireman. He was inducted August 5th, 1918, and sent to Camp Hill, Newport News, Virginia, where he was attached to the 326th Company, Fire and Guard Detachment. He was honorably discharged August 28th, 1919.

In December, 1917, Eugene W. Commery left the employ of the Engineering Department to accept a position as assistant physicist with the Bureau of Standards at Washington, D. C. His task pertained to the testing and approving of military searchlights, trench signal lamps, signalling flares and acetylene generators for field work. Commery remained with the Bureau of Standards until April 1st, 1919, resuming at that time his work with the Engineering Department.



Sidney C. Caswell Horace W. Beck Douglass M. Wood
William McLure Rosborough John H. Gage
Robert C. Hennecke William H. Pindell Joseph J. Rick



Raymond Perry
Frank E. Kopecky
Charles C. Doty
Howard Sotzen
Ralph Nash
Russell P. Askue
Lester W. Lyons
Andrew J. Brown
Perry M. Frear
Lance C. Ballou

THE ARMY FORCES

SALES DIVISIONS

The service which the men in the Sales Divisions of the National rendered was varied and interesting. Every branch of the service was represented, ten men fancying the Infantry, four the Engineers, two the Chemical Warfare Service, seven the Artillery, and so on through the different branches. Forty-five men in all went from the Sales Divisions and about eighteen of these had crossed the sea before the Germans saw the folly of their efforts.

THE INFANTRY

Lance C. Ballou, a salesman with the Bryan-Marsh Division, Central Falls, was a member of the distinguished 26th Division. Being commissioned a second lieutenant in the 103rd Infantry at the time of his enlistment May 8th, 1917, he trained with his regiment at Camp Bartlett, Westfield, Massachusetts. He embarked with his outfit and upon arriving in France was soon marched to the front where he saw action at Chemin-des-Dames, Toul, Chateau-Thierry and St. Mihiel. From October, 1918 to January, 1919, Ballou was attached to the Aviation Section, where he received training as an aerial observer.

At Ease, Men! Frank R. Kopecky, who in civil life was a southern representative for the Shelby Lamp Division, was a "rookie proper" when he reached Camp Pike, July 25th, 1918. Outfitted in army shoes, size 14EE, and an olive drab uniform four sizes too large for his slender frame, he recalled the days he spent as a rookie at Nela Camp when he was initiated into the mystic waters of the swimming pool. Upon standing retreat he

had his first taste of army entertainment, for the bugler ran out of breath and Kopecky with the other newcomers considered this a cause for much jollification. We must admit, however, that Frank was diplomatic, for rather than take a chance at being reproved for disrespect to a superior he saluted a Y. M. C. A. officer. As to his military service, Kopecky trained at Camp Pike, Arkansas, and Camp Dodge, Iowa, being discharged from the army January 8th, 1919.

The twelve General Orders were troublesome at times, as William C. McGrath of the Columbia Lamp Division can testify for a lad in his company. One night while resting in the guard house between reliefs, McGrath noticed the Officer of the Day approaching. The guard at the post, forgetting the proper way to recognize and advance the officer, exclaimed: "Halt! Who is thy?" McGrath was drafted September 4th, 1918, and discharged December 17th, 1918. He entered service in St. Louis and was sent to Camp MacArthur, Texas, where he was placed with Company D of the 3rd Replacement Battalion. He was later transferred to Camp Funston, Kansas.

Walter E. Trittipo of the Ivanhoe-Regent Works enlisted May 13th, 1917, in the First Officers' Training Camp at Fort Benjamin Harrison and upon completing the course was commissioned a captain of Infantry. He was assigned to the 158th Depot Brigade at Camp Sherman, where his duties consisted of training and equipping raw recruits. He was discharged July 15th, 1919, holding at that date the rank of major.

Russell P. Askue, who prior to entering service was Advertising Manager of the Ivanhoe-Regent Works, was assigned to the 41st Company, 11th Battalion, 159th Depot Brigade at Camp Taylor. During the influenza epidemic at that camp, Russell was detailed as stretcher bearer with an ambulance unit. He observes that the names of the other members of the crew were Oxley, Minks and Fox and that the job was a beastly one. He was soon transferred to the Central Officers' Training School at Camp Pike, Arkansas, where he was stationed at the close of hostilities. Upon leaving the army, he was employed by the Publicity Department.

Ralph C. Nash of the Peerless Lamp Division was inducted April 1st, 1918, and assigned to the 331st Infantry of the 83rd Division at Camp Sherman. He was later transferred to the officers' training school at Camp Taylor. Upon

Doughboys Watching an Exciting Game—Can the Reader Guess?

(Both photographs supplied by M. S. E., Hollis Townsend)

Loading Bread for Soldiers' Rations

Rheims in Ruins

Ruins at Chateau-Thierry

the completion of his course he went overseas with the 321st Field Artillery as second lieutenant.

Drafted in September, 1917, William A. Wallace, a born Scot and a Yankee doughboy, was sent to Camp Grant where he was stationed for several months with Headquarters Company of the 343rd Infantry, 86th Division. Upon arriving in France, Sergeant Wallace was attached to Headquarters Company of the 4th Provisional Regiment and located at Le Mans. Prior to entering the Infantry, Wallace was chief clerk at the Sunbeam Incandescent Lamp Division.

Captain William H. Pindell, Jr., a Sterling salesman, was commissioned upon completing the course at the First Officers' Training School at Camp Lee, Virginia. He was assigned to the 7th Company, 5th Provisional Regiment, at Fort Myer, Virginia, and later commanded the 48th Machine-Gun Battalion of the 16th Division. Pindell was discharged December 5th, 1918, after being on duty at Camp Gordon, Camp Perry and Camp Kearny.

William F. Hanneman of the Bryan-Marsh Division, Chicago, was drafted September 5th, 1918, and entrained for Camp Grant where he was attached to the 15th Company, 2nd Regiment, 161st Depot Brigade. He was discharged from the Army March 3rd, 1919, and accepted an appointment as Army Field Clerk at Camp Grant.

THE ARTILLERY

Field Artillery

To Lieutenant Leroy C. Doane, known among his friends as "Tiny," with his six feet, three inches of manhood, goes the honor of being in several major actions engaged in by the American troops. Enlisting May 15th, 1917, he was commissioned a second lieutenant and assigned to Battery D of the 103rd Field Artillery, 26th Division. He went to France the first of September, 1917, and on February 1st, 1918, was along the front line trenches, where he was stationed for ten months. During this time he saw action in the following sectors: Chemin-des-Dames, Toul, Chateau-Thierry, St. Mihiel, Verdun and Argonne. He was wounded in the leg by a high explosive shell and spent six weeks in the hospital. Regarding this experience, Tiny wrote from France:

"At about four in the morning the Huns landed six shells near our Post of Command, which consisted of a piece of canvas stretched across a rope. These shells knocked out three of our telephone men, and myself. One man was rather seriously injured, but the rest only slightly shaken. My leg felt as if someone had hit me in the shin with a good sized club. It didn't bother me much, so I went along until after eight o'clock before the doctor caught me. The Doc shipped me off, much to my disgust but, as usual, he was right. At the first hospital they took an X-ray and found some splinters or something. Anyway, they found an excuse to slice me open along the shin-bone from the ankle to about half-way to the knee and I haven't walked since. They sewed me up yesterday and told me I ought to be out in a couple of weeks—that is—walking around. Wasn't it rotten luck to get knocked out of that pretty job of Hun-chasing? The fellows that got part way over before they stopped something, say that our artillery simply chewed the German's fortifications to pieces. I hope I am back again before it is too late to get a crack at Metz." Tiny's wish came true, for he returned to the front before the armistice was signed.

It must be said that Tiny remained very faithful to his friends on this side of the water, sending them many interesting letters. For example, a few lines written before going to the front:

"I wish you folks would write me some news about the war. We don't get much about it over here, except the little sham battles that we play at every day. We have been promised a Christmas present of practice in the gas chambers and shooting gas shells at dogs, but that hasn't any thrilling appeal to me. The only thing that surprises me is that they don't call for volunteers to take the places of the dogs."

After being at the front for some time, he writes:

"When I am at headquarters I have a room in a wooden shack and it is very comfortable, but at the battery position we live in dugouts about twenty feet underground and the quarters are extremely cramped for one of my architecture (six feet, three inches). But I'd rather be bent double from living in a hole in the ground than get bent double by a Boche cannon—and then get put in a hole." Doane was discharged April 15th, 1919.

The 135th Field Artillery drew Sydney C. Caswell of Nela Specialties Division. He enlisted July 30th, 1917, and was assigned to Battery F. After training at Camp Sheridan, Alabama, he went overseas, being located for some time at Camp De Souge, Bordeaux, France. Sid was promoted to first lieutenant and saw action at St. Mihiel, Marbache and Meuse-Argonne.

Perry M. Frear, also of Nela Specialties, enlisted in the Second Reserve Officers' Training Camp at Fort Benjamin Harrison, August 27th, 1917, and received a commission as second lieutenant. He was assigned to the 19th Field Artillery, 5th Division, and before going overseas was stationed at Leon Springs, Texas, and Camp Upton, Long Island. Upon reaching France, Frear spent six weeks on the Western Front during the months of July and August, 1918.

What's in a Name? Lieutenant Andrew J. Brown of the New York Federal Miniature Lamp Division began service October 3rd, 1917, with the 318th Field Artillery, 81st Division, at Camp Jackson, and was later transferred to the 35th Field Artillery, 12th Brigade, 12th Division, at Camp McClellan, where he was on duty as regimental subsistence officer, regimental exchange officer and in charge of the Officers' Mess and Officers' Club. "Joe" tells this one on himself. The second day in camp his name was confused with that of an illiterate's and he was transferred to a company of illiterates and put on duty driving four mules to a refuse wagon. Brown confesses that he soon proved his normal mentality and was again placed in good standing.

Another artilleryman was Clyde W. Scharringhausen, who was employed as a stock clerk with the Columbia Lamp Division. He was drafted July 23rd, 1918, and attached to Headquarters Company, 29th Regiment, at Camp Funston, Kansas. He was discharged February 4th, 1919.

John H. Gage of the Fostoria Incandescent Lamp Division enlisted August 24th, 1917, in the Second Officers' Training Camp at Fort Niagara, New York. He successfully completed the course and was commissioned a lieutenant of Field Artillery. His first assignment was at Camp Devens, Massachusetts, where he remained until called for overseas. In France "General" Gage was located at Camp Valdahon and Camp De Souge.

Philip J. Bauman was called to the army August 21st, 1918. After some time at Camp Zachary Taylor with the 38th Company, 159th Depot Brigade, he was transferred to Camp

Knox, Kentucky, where he was on the roster of Battery D, 67th Field Artillery Regiment. When discharged December 21st, 1918, he was employed by the Ivanhoe-Regent Works.

Howard J. Tait, also of the Ivanhoe-Regent Works, was inducted May 24th, 1918, and sent to Camp Gordon where he was with the 3rd Company, 1st Infantry Replacement Regiment. He was transferred to Camp McClellan, Alabama, and still later to Camp Zachary Taylor, Kentucky, where he attended the Field Artillery Training School. At the date of his discharge, December 6th, 1918, he ranked as regimental sergeant-major.

COAST ARTILLERY

Lamp Salesmen Make Creditable Records

Two Chicago Bryan-Marsh boys, Walter Hall and Douglass Wood, had similar experiences. Both enlisted, and both were commissioned lieutenants in the Coast Artillery. Each was stationed for a time at Fort Monroe, later met overseas and participated in the same sectors.

Hall enlisted May 15th, 1917, in the First Reserve Officers' Training Camp at Fort Snelling, Minnesota, and was transferred to the officers' training camp at Fort Monroe, Virginia. He was commissioned a first lieutenant August 15th, 1917, and on the 7th day of September embarked at Hoboken for France. Arriving at St. Nazaire, September 20th, he was assigned to the Heavy Artillery School at Camp de Mailly, where he was on duty until December. Hall was then transferred for duty with the 51st Regiment of Coast Artillery until March, 1918. Subsequent points in Hall's service record were:

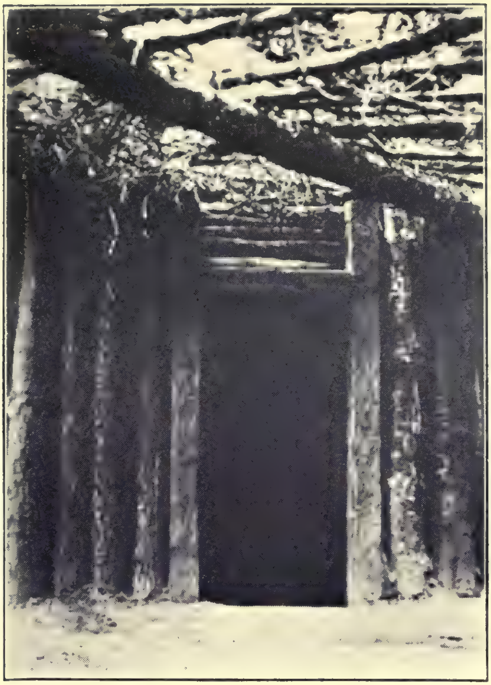
(a) Army Artillery Headquarters, First Army, March, 1918 to June, 1918.
(b) 51st Coast Artillery, Toul Sector, June, 1918.
(c) Duty L'Ecole de Telemetrie d'Artillerie, American Section, June to September, 1918.
(d) Promoted to captain, September, 1918.
(e) Commanding Officer, 1st Provisional High Burst Ranging Section, Verdun sector, October to November, 1918.
(f) Duty Heavy Artillery School, November, 1918.
(g) With Battery F, 64th Coast Artillery Regiment, December, 1918 to March, 1919.

Ready to Fire

(Photograph furnished by Private William Ross)

Near Verdun

(Photograph furnished by Lieut. Wilber Johnson)



Entrance to a Dugout
(Photo furnished by Private William Ross)

Near Chateau-Thierry—Hill 204 in the Background
(Photo supplied by Miss Laura E. Moore, S. R. C.)

Walter sailed from France February 10th, 1919, and was discharged from service at Camp Grant, Illinois, April 2nd, 1919.

Douglass Wood entered the Second Reserve Officers' Training Camp, August 27th, 1917, and received his commission as second lieutenant at Fort Monroe, Virginia. He left for overseas immediately after being commissioned, and upon arriving in England was stationed at the American Rest Camp, Morn Hill, Winchester, from January 1st to January 11th, 1918. On January 12th he crossed the Channel to Le Havre, France, and was assigned to the Heavy Artillery School at Camp de Mailly. The following month was taken up with a tour of observation and instruction along the French Fourth Army front, north of Chalons-sur-Marne. On March 13th "Doug" was assigned to Battery "A," 53rd Regiment of Heavy Artillery, and was on duty with that outfit until April 6th, 1918, when he was assigned to the 51st Field Artillery Brigade of the 26th Division as Intelligence Officer on the staff of Brigadier-General Lassiter and later Brigadier-General Dwight E. Aultman. From April 7th to November 11th, 1918, Major Wood, as he later became, was occupied in the following operations:

(a) defence of Toul sector, April 7th to June 28th.
(b) defence of the Marne, from Hill 204 to west of Torcy, July 10th to 18th.
(c) offensive, "Second Battle of the Marne," July 18th to August 4th.
(d) reconnaissance and preparation for the St. Mihiel offensive, last week in August and first week in September.
(e) Intelligence and Assistant Operations officer, Aisne Grouping, Army Artillery.
(f) Meuse-Argonne offensive, October 17th, 1918 to Nov. 11th, 1918; headquarters Fifth Army Corps under command Major-General Charles P. Summerall,—Artillery Section, Brigadier-General Aultman. Remained with this organization.

Wood was discharged April 12th, 1919.

Mr. G. E. Summerhayes, who was assistant to the sales manager of the Duplex Lighting Works, was called in October, 1918, and assigned to Battery E of the 30th Regiment of Coast Artillery. He was stationed at Camp Eustis, Virginia.

MACHINE-GUN

On December 1st, 1918, a new sales department of the National Lamp Works was organized. It was known as the Duplex Lighting Works, and in its personnel were several ex-service men whom it is a pleasure to consider as being National men in the war. Among this number, in addition to Mr. Summerhayes, just mentioned, was its Assistant General Manager, Guy P. Norton, who was a member of the Machine-Gun Company of the 23rd Regiment, New York Guards. He enlisted in the summer of 1918.

Raymond Perry of the Ivanhoe-Regent Works was commissioned a first lieutenant of Infantry after completing the course at the Second Officers' Training Camp. He was assigned to Camp Sherman and transferred to the 322nd Machine-Gun Battalion, with which regiment he went overseas. Perry was discharged April 24th, 1919.

Marvin L. Moran was drafted and assigned to the Machine Gun Company of the 77th Infantry, 14th Division, at Camp Custer, Michigan. Upon being discharged from service, January 17th, 1919, he was employed by the Michigan Bryan-Marsh Division.

ENGINEER CORPS

The Sales Divisions established an unique record in that every man enlisting in the Engineer Corps saw service overseas. John C. Murray, stockman for the Buckeye Lamp Division, enlisted July 14th, 1917, with the 112th Engineers Upon reaching Camp Sheridan, Alabama, he was assigned to Company E. On July 5th, 1918, Murray landed in France and two weeks later the 112th Regiment was moved to the Alsace-Lorraine sector, where it held the lines until September 14th. Other engagements in which Murray took part were:

Argonne offensive, September 14th to September 23rd.
Thiaucourt, St. Mihiel sector, October 1st to October 12th.
Ypres-Lys, 1st and 2nd offensives.

On November 11th, 1918, Murray was at Synghen, Belgium.

Charles C. Doty of the Buckeye Division had an interesting army life. He was drafted April 29th, 1918, and assigned to Company F, 308th Engineers, at Camp Sherman, where he was stationed until May 27th. On June 4th he sailed for

France aboard the steamer Kyber, landing at Liverpool, England, June 16th. Arriving in France, another month was spent in further preparation for duties at the front. His regiment left Chaugey for the front on July 25th and then began Doty's participation in the following battles:

Aisne-Marne offensive, July 28th to August 6th, 1918.

Oise-Aisne offensive, August 18th to September 9th.

Meuse-Argonne offensive, September 26th to November 11th.

The morning of December 1st, Doty arrived at Oldsdorf, Germany, and on December 14th, he crossed the Rhine at Urnietz. He remained with the American Army of Occupation until May 13th, 1919, returning to the United States aboard the French liner La Savior.

Inducted September 21st, 1917, Joseph J. Rick of the Sterling Division was sent to Camp Grant, Illinois, and assigned to Company A of the 311th Engineers, 86th Division. After eleven months' training at Camps Grant, Pike, Dix, Merritt and Upton, Rick was sent overseas where he was on duty for six months in England and France. He had meanwhile been transferred to Headquarters Company of the 345th Infantry, 87th Division. Rick was discharged February 3rd, 1919.

TANK CORPS

William McLure Rosborough, when the United States declared war with Germany, was southern manager for the Shelby Division and had his office in Atlanta, Georgia.

Rosborough applied for a commission in the Engineer Reserve Corps and was granted a 1st lieutenancy. He was called to active duty on September 2nd, 1917, and was ordered to the Second Engineers' Training Camp at American University, D. C., where he remained on duty six weeks. He was then assigned to the General Engineer Depot, Washington, D. C. In February, 1918, while he was acting as assistant to Col. W. H. Rose, Commanding Officer, he was allowed to transfer to the 65th Engineers (the Tank Detachment of the Engineers). After a month in Washington where he was on duty with Colonel H. G. Ferguson, Tank Corps organizer, he was ordered to Company C, 301st Battalion, Tank Corps. He joined his organization at Camp Meade and one month later was on his way to the other side.

The 301st arrived in England early in April. The entire outfit was detailed under British instruction at Wareham, England, until August, moving from that center to the port of debarkation at Havre, France. Here they remained but a few days before entraining for the front. At Bapaume they took over and added to the equipment of the 10th Battalion, British Tank Corps, until it had reached a strength of forty-eight of the heavy tanks known as English Mark 5 and Mark 5*.

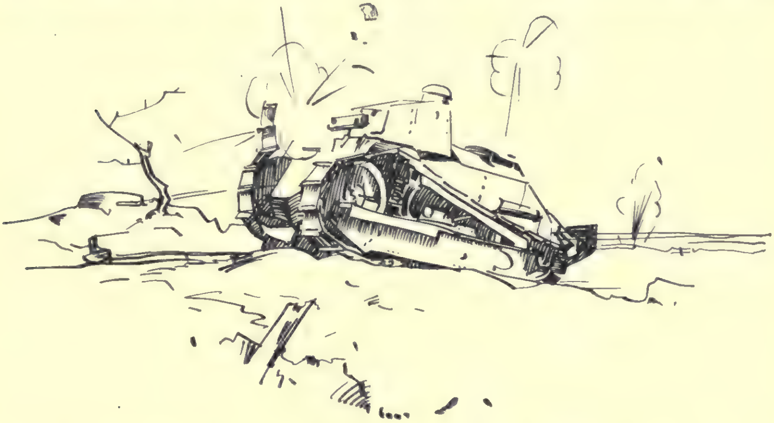
"Rosie" went into action in the Second Battle of Cambrai on the morning of Sunday, September 29th, 1918, experiencing in this engagement the thrills of action, wounds, capture, escape and all the lurid thoughts and fears which must necessarily possess the mind of one who, alone on hostile terrain and without means of protection, roams and suffers for two days and two nights.

The army objective in this drive was the tunneled portion of the St. Quentin Canal midway between Cambrai and St. Quentin. It was a four-mile stretch and was strongly fortified, being a part of the renowned and "unbreakable" (?) Hindenburg Line. The American line at this date was approximately four kilometers west of this point. According to the plan of advance, Rosie's platoon of five tanks, posted near the town of Ronssoy, was directed to form a part of the second wave of the attack, following up and assisting the infantry of the 27th Division of the American troops.

At zero hour (5:40 A. M.), Lieutenant Rosborough gave the tank commanders the order to advance. Due to darkness and climatic conditions the attack was not carried out as organized and before seven o'clock, after advancing a distance of less than two miles, the tank in which Rosie was riding became separated from the other four tanks of his platoon and got considerably in advance of the infantry as well.

Besides Lieutenant Rosborough, the tank on which our interest centers contained a second lieutenant and ten enlisted men, one of whom was killed shortly after the advance was begun, being struck by an anti-tank rifle bullet which had penetrated the tank.

The terrain in this vicinity was moderately hilly and from a depression down which the huge caterpillar was crawling, it was possible to observe the enemy trenches as they zig-zagged away up the slopes. Some of them contained only a few men and the machine gunners fired on these as their tank crossed over. But finally, as one trench was approached, it was seen that it was strongly held by German machine gunners farther up the hillside. So the tank crossed it and began nosing along behind it, meanwhile pouring machine-gun and six-pounder fire into the enemy. At this point a German field piece, concealed in a hedge at the crest of the slope, took a hand in the game and scored a hit, but got it down in the running gear where it did no material damage. The crew recognized the danger, and immediately turned their attention to this more formidable enemy, but he was so located that he got in another shot before those in the tank could maneuver into a position from which to fire upon him effectively. This last shot was well aimed. It penetrated the tank armor at the front of the machine and exploded in the midst of the crew. The engine was put out of commission and five men were killed. The remaining six were all wounded but were able to get out of the tank and into a shell hole. Rosie, besides being wounded in the right wrist and left shoulder was badly burned on the hands and face by a gasoline blaze. They removed the large first-aid kit from the tank as well as two machine-guns with which to protect themselves should the enemy attack, and lay in waiting all that day, giving one another first aid and wondering what their fate was to be.



Their position was serious because the trench which they had been firing upon was only about three hundred yards away and was between them and their own troops. Rosie decided that the safety of his men depended upon getting back to the American lines and summoning help. Starting out alone, he crept from shell-hole to shell-hole, taking a roundabout course in order to avoid detection. Finally, having gone as far as was prudent in daylight, he waited for darkness and then started again. Soon afterwards he came upon a group of wounded Yanks who informed him that an American machine-gun crew had set out a short time before in the direction of the tank. Desirous of overtaking this party and of effecting the rescue of his men, Rosie turned back again.

In the darkness it was hard to distinguish friend from foe, and the machine-gun that he was headed for was firing spasmodically as temporary halts were made. Obviously, he was in no little danger of being mistaken for an enemy. At last, edging his way around an angle in the trench to which he had trailed the machine-gun, he saw faintly silhouetted against the sky, two unmistakably German helmets. Thinking that possibly he had not been observed, Rosie slipped into a small ammunition dug-out to await developments.

Captured—For a Few Minutes

These came only too soon. He had barely hidden himself when a third German filed past, said a few words to the other two, and then retraced his steps. When directly in front of Lieutenant Rosborough, he stopped and drew his pistol. Realizing that resistance was worse than useless, and believing his only hope for safety depended upon giving himself up and feigning injuries more serious than they were, Rosborough stood up, explaining to his captor that he was in dire need of aid.

Unheeding his plea and making no effort to search him for possible weapons or valuables, the three Germans started to march Rosie off in the direction of their rear. His only hope lay in attempting to break away and escape in the darkness.

Rosborough Escapes in the Night

The Hun who led the way was short of stature and Rosie, as if unable to advance unaided, placed his left hand upon the German's left shoulder. The German did not resent this, so he brought his right hand to his captor's right shoulder, meanwhile watching for a place where some friendly shell had battered down the side of the trench sufficiently to help him get away quickly. He had not gone far when the opportunity came. Giving the leading Boche a sudden thrust forward, he jumped over the parados and was swallowed up by the night before his enraged captors could make a move to stop him.

Hours elapsed. Finally, after much wandering about between the German lines, Rosie succeeded in getting back to his tank, only to find the second lieutenant and his men gone.

Weary, and unprotected from the rain which had been falling all night, Lieutenant Rosborough secured rations from the tank and in the early hours of Monday morning dug himself in under the battle-scarred old hulk. Here he rested all that day and the next night, hoping that on Tuesday he would be sufficiently recuperated to make his way to the American lines.

He was awakened Tuesday morning by voices coming from the direction of a plane, which had been shot down not far from the tank. Still weak and slightly shell-shocked from his experiences of the past two days and nights, he crawled out and got up into the wreck of his Juggernaut. He could see the strangers but was unable to tell positively whether they were friends or foes. They wore the helmet-covering and the blouse peculiar to the Australians but still Rosie was not firmly convinced that he should show himself. He did not know that pressure on each side of his position had made the Germans evacuate the whole area, and he did not propose to take chances on being captured again.

Once more summoning his strength, he left the tank and crept from shell-hole to shell-hole until within hearing distance of the group. Meanwhile, a few of the onlookers had rambled off in the direction of the tank and as they were retracing their steps passed the shell-hole in which Rosie lay. Convinced that he was in friendly hands, Lieutenant Rosborough made himself known to a surprised and welcoming group of Australians who gave him medical attention and brought him to an American first-aid station.

He was removed to a hospital at Rouen, where he met his second lieutenant. The latter and his men had given Rosie up for dead and had set out to work their way through the German lines. Fortunately, they had escaped capture and had arrived within the American lines early Monday morning.

From Rouen, Rosie was removed to a hospital in London where he was under treatment until December 1st, 1918, when he rejoined his battalion in France. He returned to the United States in March, going to Walter Reed Hospital in Washington, D. C., to have shrapnel removed from his left shoulder. Upon being discharged in July, 1919, he joined the Engineering Department.

The National laments the death of Lewis Mark Comiskey, which occurred nine days after he had been discharged from service. Lewis was born August 26th, 1899, in Chicago, Illinois, and at the time he entered service was employed by the Ivanhoe-Regent Works. He applied for enlistment in the Marines, Aviation and Tank Corps and was called October 26th, 1918, in the latter branch of the service. Comiskey was assigned to Company A, 340th Battalion, which was mustered in at Camp Polk, Raleigh, North Carolina. Lewis was later transferred to Camp Greene where he was attached to the 72nd Company, 18th Training Battalion of Infantry.

While Comiskey was stationed at Camp Greene the armistice was signed and he was soon sent to Camp Grant to be mustered out. He received his honorable discharge January 2nd, 1919, and died January 11th. Comiskey's life was an exemplification of true and stanch American principles. He enlisted at the age of nineteen years and would have been in service earlier had his brother, who was with the American forces in France, not insisted that his duty was at home. In his death we lost a "one hundred per cent American."

GAS REGIMENT

Among those on the roster of a gas regiment company was Joseph J. Hannemann of the Bryan-Marsh Division, Chicago. Entering service February 25th, 1918, he was assigned to Company E of the First Gas Regiment at Fort Myer, Virginia. Upon landing in France, he was detailed to the front, where he saw action at:

St. Mihiel, September 12th to September 15th, 1918.
Argonne Forest, September 25th to October 18th.
Meuse-Argonne, October 30th to November 11th.

Unfortunately Hannemann gave us none of his experiences, but as he participated in three big offensives we know his overseas period must have included a great many thrilling moments.

SIGNAL CORPS

The one National salesman in this branch of the service was Robert C. Hennecke of the Federal Miniature Lamp Division, Chicago. He was voluntarily inducted June 28th, 1918, and sent to Fort Leavenworth, Kansas, where he was detailed with the 15th Service Company from June 28th to July 23rd. He was then transferred to Company B of the 214th Field Signal Battalion at Camp Custer, Michigan, where he was stationed until discharged from the Army January 23rd, 1919. Bob rose to the rank of sergeant, 1st class.

CHEMICAL WARFARE SERVICE

Two men from the Sales Divisions enlisted in the Chemical Warfare Service. Walter H. Weeks of the Bryan-Marsh Division, Rhode Island, enlisted August 1st, 1918, in the Research Division and was located for some time at American University, Washington, D. C. He later passed an examination for a commission as first lieutenant in the Motor Transport Corps and was about ready to leave for overseas duty when the armistice was signed. Walter was discharged December 1st, 1918. Howard Sotzen of the Shelby Lamp Division enlisted July 31st, 1918, in the Defense Division and was commissioned as second lieutenant. He was located at the Offense Laboratories in Cleveland until discharged, January 9th, 1919.

ORDNANCE DEPARTMENT

Fred C. Laufketter of the Fostoria Lamp Division entered the Ordnance Department October 8th, 1918, with the rank of production engineer in the St. Louis District. He was kept busy with the task of increasing shell production. Under his jurisdiction were contracts amounting to nearly two hundred million dollars. As a reward for his work he received from the Government a Loyal Service Medal and a Certificate of Loyalty.

QUARTERMASTER CORPS

Benjamin H. Hoerlein of the Buckeye Lamp Division was a sergeant in the Quartermaster Corps, having enlisted in Chicago, Illinois, December 19th, 1917. Ben was located at Camp Johnston, Jacksonville, Florida, and later at Eberts Field, Lonoke, Arkansas.

MEDICAL UNIT

Lester W. Lyons of the Sunbeam Division enlisted in the Medical Corps at Fort Jay, Governor's Island, New York, December 10th, 1917. After spending some time in the Stores Distribution Department, he was transferred to the Base Hospital at San Juan, Porto Rico. He was later assigned to Camp Las Casas where he was made sergeant. Lyons was discharged April 30th, 1919.

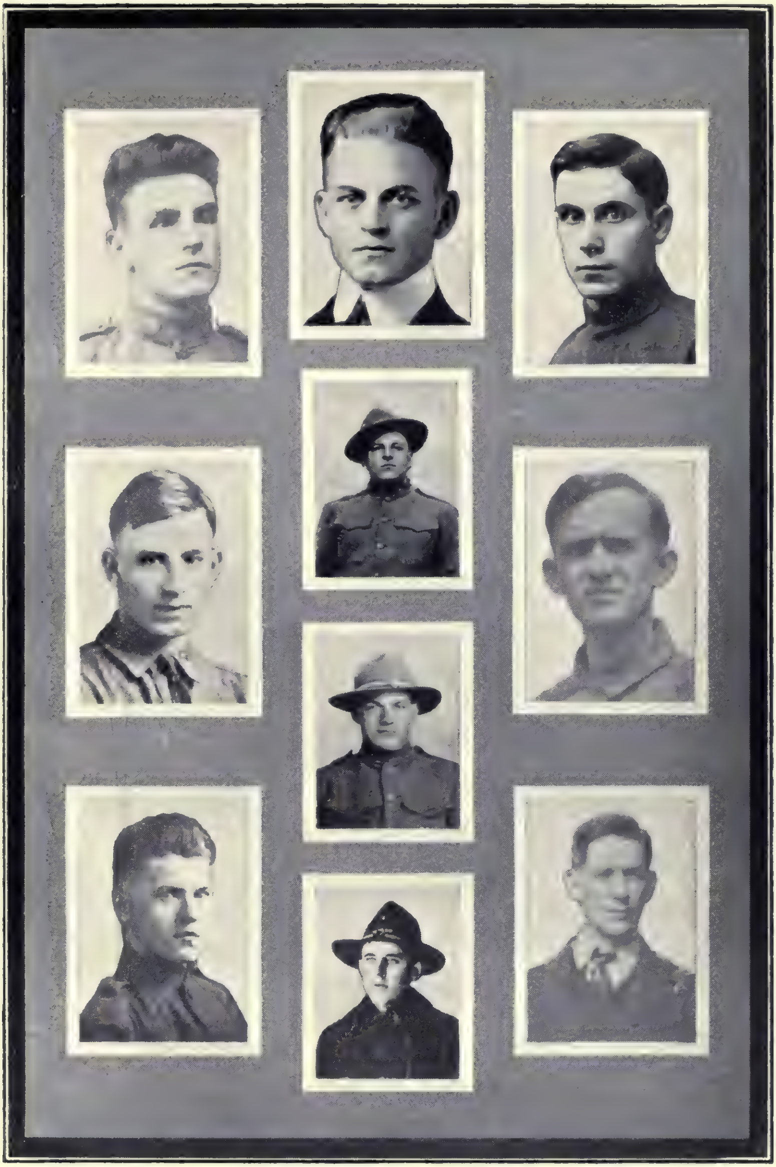
AMBULANCE

Columbia Lad Earns Croix de Guerre

One of the medal wearers of the National Lamp Works was Horace W. Beck, Jr., of the Columbia Lamp Division. He enlisted November 5th, 1917, in St. Louis, in the Ambulance Service and upon arriving at Allentown, Pennsylvania, was assigned to Section 516, with which outfit he went overseas. Beck took part in the following engagements:

(a) Alsace defensive, February 11th to April 2nd, 1918.
(b) Soissons-Noyon defensive, April 12th to April 20th.
(c) Somme defensive, April 26th to August 7th.
(d) Somme offensive, August 8th to August 11th.
(e) Oise-Aisne offensive, August 28th to September 18th.
(f) Oise-Somme offensive, October 13th to November 9th.

As a reward for his brilliant and heroic conduct under fire, he was awarded on February 14th, 1919, the Croix de Guerre and a citation covering the periods from August 9th to September 15th and from October 10th to November 4th, 1918. Beck was discharged April 25th, 1919.



These men were among those who died for their Country

Harry E. Peffer

Harmon E. Whiteman

James E. Sullivan

Jesse S. Gardner
Robert T. Coughlin

Enoch E. Brooks

George C. Clancy

Ray L. Swartz

Edward F. Hartman

Clarence Hammell

Herbert L. Anderton　Arthur J. White　Uhl M. Smith
Theodore G. Chadwick　Charles Jones　Robert Jones　Clarence Clark
Leo Lucas　Frank C. Williams　Herman Glave
John H. Ziegler　John F. Cannon　David Stambler

THE ARMY FORCES

MANUFACTURING DIVISIONS

The Manufacturing Divisions gave by far the largest number of men to the war from the National and fully 45% of those going into service went overseas, participating in some of the most gruesome and significant engagements fought during the entire conflict. Six of these men were killed in action; two died from the effects of wounds; one met death in an accident, while eight died from natural causes.

THE INFANTRY

One of the most notable of National's heroes was David Stambler of the Puritan Refilled Division. This lad, nineteen years of age, measuring but five feet, four inches in height, enlisted on May 21st, 1917, in Company H of the 104th Regiment, 26th Division. After a period of infantry training at Lynnfield, Massachusetts, he was sent overseas where he served fourteen months, six of them at the front. He saw action with the 26th Division at Soissons, Toul, Seichprey, Apremont and Chateau-Thierry. It was in the battle of Chateau-Thierry that he was so badly wounded as to be crippled for life. For his heroism and devotion to duty in this battle he was decorated by the French Government with the Croix de Guerre. Young Stambler was a hero among heroes, for his regiment was the first American regiment decorated by a foreign country.

Ray Swartz Meets Death in the Argonne

Another hero and a man who died fighting for his country was Ray Leland Swartz of Ohio Division. Enlisting in the 5th Ohio National Guard, he first saw duty along the Texas border during the Mexican trouble in 1916. From there he was sent to Camp Sheridan, where he was promoted to sergeant. He went overseas with the 145th Regiment of Infantry, 37th Division, and while playing his part in the action in the Argonne Forest on September 29th, 1918, he was hit between the eyes by a machine-gun bullet and instantly killed. The death of Swartz was a sad loss to his comrades and the following letter, written to Ray's mother by his former commander, shows the high esteem in which the lad was held:

> "Your letter in regard to the death of your son fortunately came to me as I am now in command of Company D. I joined Company D at Camp Sheridan and there first became acquainted with your son. From then until his death he was my platoon sergeant, always faithful, always dependable and a strong and popular leader of men.
>
> "For a whole month Sergeant Swartz was in sole command of a platoon on our first trench occupation against the enemy. He carried himself with credit and held the confidence of his men in danger.
>
> "In the Argonne battle, our first offensive, he was my invaluable aid in cheering and inspiring the men and in his aid to the wounded. Our platoon advanced the farthest objective of the first day and held it over night. The next day we advanced farther forward, making our total gain on the Germans about ten miles. It was on the third day, while advancing under terrific machine gun and artillery fire, that your son was killed. He was not over a foot from me when he was hit by the bullet of the machine gun. He said, 'Lieutenant, I am hit', very calmly. I asked him 'Where?' and he said 'pretty high.' He died a few minutes later.
>
> "We have never ceased to miss this sterling, brave, indomitable Sergeant.
>
> "The Chaplain, Charles Funnell, remembers having found the body and says that he gave him an honorable burial.
>
> "I hope this letter will be satisfactory to you. I am very much in sympathy with you, his mother. He died for a great cause; he died a man, a soldier respected and honored; he died a hero in the service of the great American army.
>
> Sincerely,
>
> W. H. STEWART,
> Lt. Inf., U. S. A."

Fred S. Gregory, another Ohio Division employee, likewise served along the Mexican border with the Ohio National Guard and was later transferred to Camp Sheridan with the 145th Infantry, 37th Division, eventually landing in France. After a period of training at Illuod, France, his regiment was ordered to the Alsace-Lorraine, Baccarat sector, where they occupied trenches for eight weeks, moving on September 26th to a sector near Verdun. Here on September 26th they entered the Argonne Forest drive. They were located at this point until October 7th, when they were removed to the St. Mihiel sector at Thiaucourt, where they held the lines until October 20th. Once more were they moved, this time to a sector west of Thielt, Belgium, where on October 31st they began another offensive. On the same day Gregory was wounded and taken to British Expeditionary Force Hospital No. 8. He remained there until December 11th, 1918, when he was removed to the United States Hospital No. 37 at Dartford, Kent, England. On January 20th, Gregory sailed for home. Upon being discharged from service he took employment with the Pitney Glass Division.

From Mexico to France

Thomas J. Molloy of the Nela Lamp Division was another boy who saw strenuous service. Enlisting in 1916, in the 145th Infantry, he was for a time along the Mexican border, but finally reached France, where he saw action in the following engagements:

(a) Baccarat sector, August 4th to September 16th, 1918.
(b) Avocourt sector, September 21st to Septmber 25th.
(c) Meuse-Argonne offensive, September 25th to October 1st.
(d) St. Mihiel sector, October 7th to October 16th.
(e) Flanders offensive, forcing crossing of Lys and Escaut Rivers, October 31st to November 4th.
(f) Flanders offensive, forcing crossing of Escaut River at Lyngem, November 9th to November 11th.

Anthony S. Greisen of the Minnesota Mazda Lamp Division entered service with Company D of the 352nd Infantry, 88th Division, and was transferred April 6th, 1918, to Company H, 132nd Infantry, 33rd Division. After training at Camps Dodge, Iowa, and Logan, Texas, he sailed for France. Among the engagements in which Greisen took part were the following:

(a) Occupation of Vaden Line with the 3rd Corps, British Expeditionary Force, June 23rd to August 23rd, 1918.
(b) Amiens sector, attack on Hamel Woods, July 4th.
(c) Verdun sector, west of the Meuse, September 8th to September 25th.
(d) Meuse-Argonne offensive, September 26th to October 20th.
(e) Offensive of Troyon-sur-Meuse sector, October 25th to November 11th.

The 33rd Division, to which Greisen was attached, claims to be the only Division that fought with the English, Australians and French. It also served in five armies and eleven Army corps. Greisen was one of the twelve National men with the Army of Occupation, wintering in Luxemburg. Upon receiving his discharge from service May 26th, 1919, he returned to his former position as foreman in the Basing Department at Minnesota.

Another infantryman was Edward P. Brennan of the St. Louis Mazda Lamp Division. He enlisted July 24th, 1917, and trained at Camp Doniphan and Fort Sill, Oklahoma. Going across with Company L, 138th Infantry, 35th Division, he participated for five nights and five days in the Argonne drive, besides holding lines in four other sectors at various times. He witnessed and suffered many hardships, and although engaging in several trench raids was never wounded. While active in the Vosges sector, his company had forty-two casualties in one night's operations. Brennan was discharged May 12th, 1919.

Among those dying while in the service was Jesse Sales Gardner of Ohio Division. He was born in Bristolville, Ohio, November 14th, 1896, and at the time of his induction, August 29th, 1918, was employed in the assistant superintendent's office, where he was doing clerical work. He was sent to Camp Zachary Taylor and attached to the 19th Company, 5th Training Battalion, 159th Depot Brigade. On September 28th Gardner was transferred to Battery A of the 67th Field Artillery at Camp Knox, West Point, Kentucky, and a few days later was taken ill with influenza. He was brought back to Camp Taylor, October 2nd, and died five days later at the base hospital, of bronchial pneumonia. His body was interred in Oakwood Cemetery, Warren, Ohio.

Leland R. Ensign, a coil bender with Ohio Division, was mustered into Headquarters Company of the 331st Infantry, 83rd Division, at Camp Sherman, January 22nd, 1918. He arrived in France June 24th, 1918, and was sent to the vicinity of Chaumont, where the regiment was kept in reserve for four weeks. Ensign was afterwards sent to a signal school and returned to his company as a signal instructor.

Herman H. P. Marshall of the St. Louis Mazda Lamp Division entered the army September 18th, 1917. Upon reaching Camp Funston he was assigned to the 354th Infantry, 89th Division. Arriving in France, he was transferred to a trench mortar platoon of the 140th Infantry, 35th Division. He took part in the following engagements:

(a) Somme sector, May 12th to June 9th, 1918.
(b) Thann sector, June 23rd to July 1st.
(c) Vosges Mountains, Gerard sector, July 19th to September 2nd.
(d) Argonne sector, September 20th to October 7th.
(e) Sommedieu, Verdun front, October 12th to November 5th.

The day fighting was halted, Marshall was marching to Metz with his regiment for an attack which was scheduled for two days later.

Missing Death By Inches

Lewis E. Burdick, a flange-machine operator with the Central Falls Mazda Lamp Division, was drafted February 23rd, 1918. He was assigned to Company K, 306th Infantry, 77th Division, at Camp Devens. After intensive training at that camp he was sent to France, where he participated in the Oise-Aisne drive in August, 1918. In that offensive his squad was among those picked as machine-gun carriers. While digging in for the night under enemy fire, a large shell burst just behind the tree where Burdick and his buddies were busy. Thinking nothing of this, they kept digging in with their mess-kits, there being but one shovel in the squad, but the next morning upon reconnoitering they found that three men in the machine-gun company had been burned to cinders on the other side of the tree. Burdick was discharged August 11, 1919.

Travelling across in the Italian cattle boat Caserta was the preliminary experience of George B. Hayman. Arriving in Brest, France, July 5th, 1918, with the 145th Infantry, 37th Division, he was soon under way again, this time to a prison camp at Grieves, France, where he was detailed to guard prisoners. On August 5th he went into the trenches in the Toul sector, along the Lorraine front, where he remained until September 15th. Dispatched to the Meuse-Argonne Forest, fifteen kilometers northwest of Verdun, he saw action there from September 26th to October 2nd. In this offensive he was wounded in the back of the head with a high explosive shell, causing perforation of the left ear drum. Recovering from this injury, he was sent to Thiaucourt in the St. Mihiel sector for two weeks and upon being relieved at that point was sent on October 17th to an officers' training school at La Valbonne, near Lake Geneva, where he remained until the armistice was signed. Upon being discharged, March 15th, 1919, Hayman was employed by the Cleveland Miniature Lamp Division.

A transfer from the 83rd to the 1st Division brought Harry E. Baldauf of the Euclid Glass Works action and wounds. Harry was drafted September 17th, 1917, and assigned to the supply company of the 331st Infantry, 83rd Division, at Camp Sherman. He was transferred to Company M of the 28th Infantry, 1st Division, and upon his arrival in France was dispatched to the front, where he saw action at:

St. Mihiel, September 12th to September 16th, 1918.
Argonne Forest, October 1st to October 6th, 1918.

On October 6th, in the Argonne Forest, Baldauf was wounded in the left hand by shrapnel, and gassed, consequently seeing no further action. He was discharged April 15th, 1919.

"*The noblest death is surely in the glorious heat of strife, where man by courage and true sacrifice, can prove to God his manhood as he dies.*"

Through the efforts of the Oakland Mazda Lamp Division we were able to obtain information regarding two of its employees who died in service, Private Francis Lee Judd and Private Clarence H. Hammell. Both were attached to the 363rd Infantry Regiment and both received their death wounds on September 26th, 1918, in the Argonne drive.

Francis Judd was drafted in August, 1918, and detailed to the 363rd Regiment of Infantry, 91st Division, at Camp Lewis. He went direct to France, where his regiment was stationed, and when troops were placed for the Argonne offensive the 363rd Regiment was dispatched to a point near Verdun. On the first day of the drive, September 26th, 1918, they were advancing fifteen miles southwest of Verdun when a shell exploded in the midst of the company. Judd was hit by a number of fragments and lay stunned. He was revived and moved to an evacuation hospital, where his wounds were dressed. Although severely hurt, Judd appeared to be doing well and later wrote home that he had recovered sufficiently

Upper Photo—Niles Glass Division, Niles, Ohio.

Middle Photo—St. Louis Mazda Lamp Div., St. Louis, Mo.

Lower Photo—Central Falls Mazda Lamp Div., Central Falls, R. I.

Illinois Miniature Lamp Division, Chicago, Illinois.

Oakland Mazda Lamp Division, Oakland, California to help about the hospital with light tasks. The next news brought word that he had died suddenly, December 17th, 1918. Judd was but twenty-three years old at the date of his death and previous to entering service had been employed in the shipping department of the Oakland plant. Letters from his superior officers characterize him as a very good soldier, honest and faithful in every particular.

The other Oakland man to die in action was Clarence Hammell. He was born January 15th, 1895, and at the time he was inducted, October 13th, 1917, was employed as a foreman. After some training at Camp Lewis he was transferred to Company D of the 363rd Infantry and sent to France. Like his buddy, Lee Judd, he received his wounds in the Argonne drive. The following extract from a letter written by a platoon commander of the 363rd Infantry, tells something of the lad's death:

"Clarence Hammell was a runner in my platoon and I considered him one of the best soldiers in the company. He was always very faithful and obedient to all orders. When our company received final instructions before going over the top in the Argonne sector offensive, I detailed Hammell as a runner or message bearer between my platoon and the company commander. Hence I did not see his death. I am told he was killed while advancing with the captain and that he died the death of a hero in the full performance of his duty. This was north of the Cheppy Woods, which is near Vauquois, France, in the Verdun region. Our division had a post of honor in the beginning of this wonderful fight of the American Army. It was here that the drive for freedom was begun and it was here that the Kaiser's mailed fist was shattered and peace brought to a war-torn Europe. It was here these heroes of the French in 1914 said 'they shall not pass,' and we all know the results of that great stand. Clarence Hammell's body lies in this famous battle-field. He was indeed a true soldier and fearless under his baptism of fire."

The devotion and heroism of these two lads, Lee Judd and Clarence Hammell, makes every National man and woman think more reverently of the twenty fellow-workmen and comrades who "went West" in the war. Their sacrifices were of the noblest kind that men can make.

Corporal George M. Nibeck, a bulb blower with the Euclid Glass Division, was drafted May 28th, 1918. At Camp

Gordon, Nibeck was assigned to Company D, 59th Infantry, 4th Division. After a short period of training at that camp he was sent to France, where he was over the top in the Metz sector, at St. Mihiel and in the Meuse-Argonne offensive. George was gassed October 19th, 1918, in the Argonne Forest.

The National Army drew George W. Myers of the Euclid Glass Works. Becoming a soldier April 28th, 1918, he received his training at Camp Sherman and Camp Merritt, being attached to Headquarters Company of the 112th Infantry, 28th Division, as a private. Myers saw action in the Thiaucourt sector with the same outfit. He was discharged from service May 19th, 1919.

William C. Boehning of the Minnesota Mazda Lamp Division was drafted July 25th, 1918. At Camp Wadsworth, South Carolina, he was attached to Company D of the Third Pioneer Infantry. Boehning also trained at Camp Stuart, Virginia, before going to France. He took his part in the Meuse-Argonne offensive from September 26th to November 11th, 1918. Russell A. Paine of the same Lamp Division entered service May 30th, 1918, and trained at Camps Gordon, Merritt and Devens. In France he was on the roster of Company D, 104th Infantry, 26th Division.

Joseph V. Hamey, a glass worker with the Euclid Glass Division, was inducted April 28th, 1918. After one month at Camp Sherman with Company G of the 329th Infantry, 83rd Division, he was detailed overseas and transferred to Headquarters Company of the 112th Infantry, 28th Division, which was located for some time at Le Mans, France. William D. Jones, a coiling-machine operator with Ohio Division, was called to Camp Gordon, May 26th, 1918. He was assigned to the 11th Company, 3rd Battalion, 1st Replacement Regiment. Jones went to France several weeks later.

James Edward Sullivan was a glass blower with the Niles Glass Works. He was born in Niles, Ohio, October 10th, 1896. On September 6th, 1918, Sullivan was drafted into the army and ordered to Camp Sherman, where he was assigned to the 28th Company, 7th Training Battalion, 158th Depot Brigade. He was taken ill soon afterwards with pneumonia and died October 9th, 1918.

Two other glass workers, entering service from the Euclid Glass Division, were Wayne F. Price and William R. Walsh. Price was drafted September 17th, 1917, and upon reaching

Camp Sherman was assigned to a supply company of the 331st Infantry, 83rd Division. Walsh was called July 22nd, 1918, and sent to Camp Jackson, South Carolina. He was placed with Company I, 89th Infantry, 20th Division. Walsh was later transferred to Camp Sevier where he remained until discharged from the army December 23rd, 1918.

Drafted into Company L of the 331st Infantry, overseas with the 19th Engineers and then transferred to the Quartermaster Corps was the service record of Walter W. Dieckow of the Lamp Equipment Division. He was drafted September 18th, 1917, and trained at Camps Sherman, Grant and Merritt. Joseph Palermo, also of Lamp Equipment, saw action at St. Mihiel, Argonne and Verdun. For five days his company was without rations but the morale of the men never waned. Palermo was drafted May 24th, 1918 and trained at Camp Gordon, Georgia.

Two boys from the Loudon Glass Division died of pneumonia while in service. One of these was Joseph Raymond Ingram,whose service record will be found on page 100. The other was James Wilbur Doll, employed by Loudon as a fireman. He was drafted July 10th, 1918, and ordered to Camp Sherman where he was assigned to Company E of the 334th Infantry, 84th Division. Doll went overseas and was in Exnal, France, at the time he was taken ill with pneumonia. He died one day before the signing of the armistice.

Robert C. Milliken, later with Trumbull, was connected with the Personnel Office at Camp Sherman, where his work consisted of interviewing drafted men as to their educational, industrial and military qualifications. He was discharged March 1st, 1919.

Joseph L. Vanness of the Euclid Glass Division entered service May 28th, 1918. He was called to Camp Gordon and assigned to the 35th Company, 9th Battalion, 3rd Replacement Regiment, while William J. Hultyman who was later employed by the Euclid Glass Works, enlisted May 28th, 1917, in Cleveland, and trained at Camp Perry, Ohio, and Camp Mills, Long Island. He was assigned to Company E, 166th Infantry, 42nd Division, and after five months' home training went to France. He participated in the following operations:

Luneville sector, February 21st to March 21st, 1918.
Baccarat sector, March 30th to April 23rd.
St. Mihiel, September 12th to September 18th.

When the armistice was signed Hultyman's work was not done, for he was with the American Army of Occupation from January 14th to April 7th, 1919.

Richard E. Dare, later with the Oakland Mazda Lamp Division, enlisted July 1st, 1917, in the 63rd Infantry of the Regular Army. He was made an instructor in grenade bayonet work and while stationed at Camp Meade, Maryland, won second prize and honorable mention in the Division rifle championship contest. On November 3rd, 1918, he qualified as an expert rifleman. As early as 1916, Dare was in the British Merchant Marine service, aboard the S. S. Atlantian which steamed between New Orleans and Liverpool. He was discharged from the army January 27th, 1919.

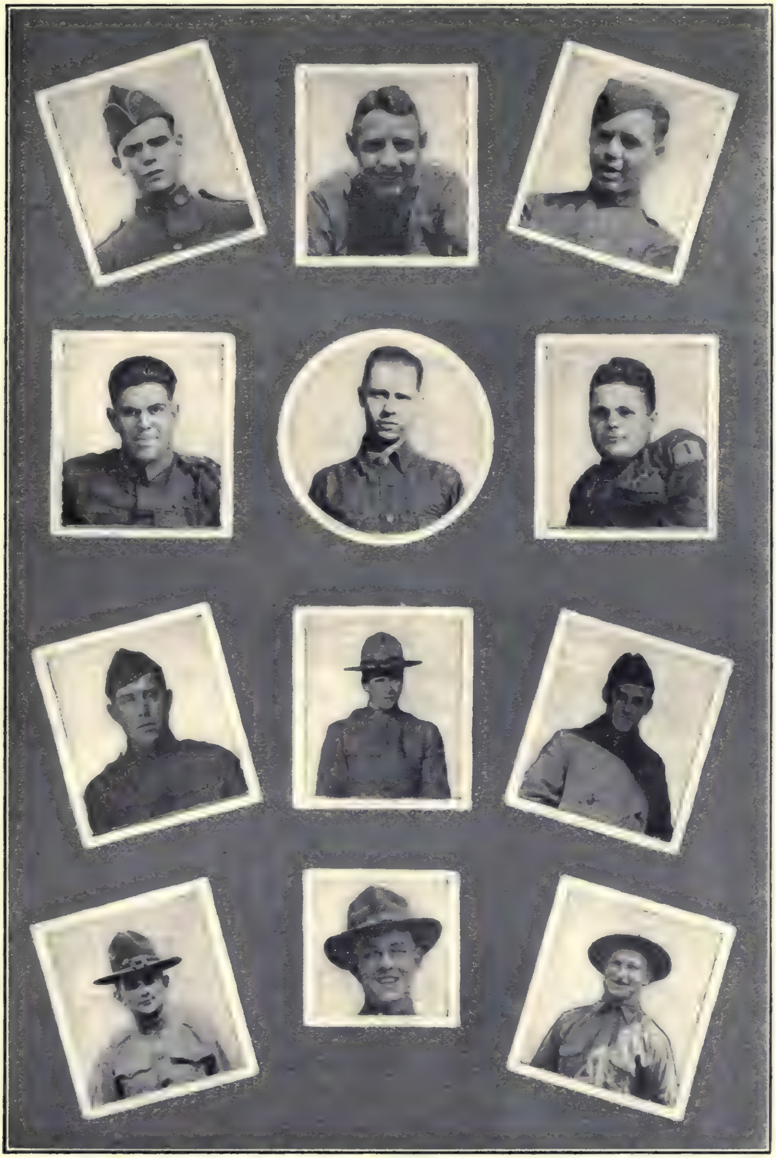
With the Providence Base Works were three boys of Italian birth who served in the Infantry. Sylvester Minncuci, a machine operator, was drafted May 1st, 1918. He was assigned to Company K, 116th Infantry, 29th Division, and trained at Camp McClellan, Alabama, and St. Lizzare, France. Pietro Paolella was attached to the 24th Company, 152nd Depot Brigade at Camp Upton, Long Island, from August 3rd, 1918 to December 12th, 1918, while Cosmo Castrovillari was assigned to the 71st Infantry at Camp Meade. He was inducted June 24th, 1918, and discharged January 31st, 1919.

Hugo Johnson of the Euclid Glass Division entered the army June 24th, 1918. Upon reaching Camp Upton he was assigned to Company L, 322nd Infantry, 81st Division, as a private. The following month Johnson went to France, where he saw action in the St. Die sector, Sommedieu sector and in the Meuse-Argonne offensive. He remained with the American Expeditionary forces until June 19th, 1919.

All Out of Luck

Being listed for early embarkation and then to have fighting cease was the luck of Oswald H. Niehus of the Cleveland Wire Division. He was originally attached to the 36th Company, 9th Training Battalion, 158th Depot Brigade, at Camp Sherman but was transferred to an infantry regiment which was assigned for convoy November 20th. The signing of the armistice spoiled the fun, for Niehus was eagerly waiting his chance to wallop the enemy.

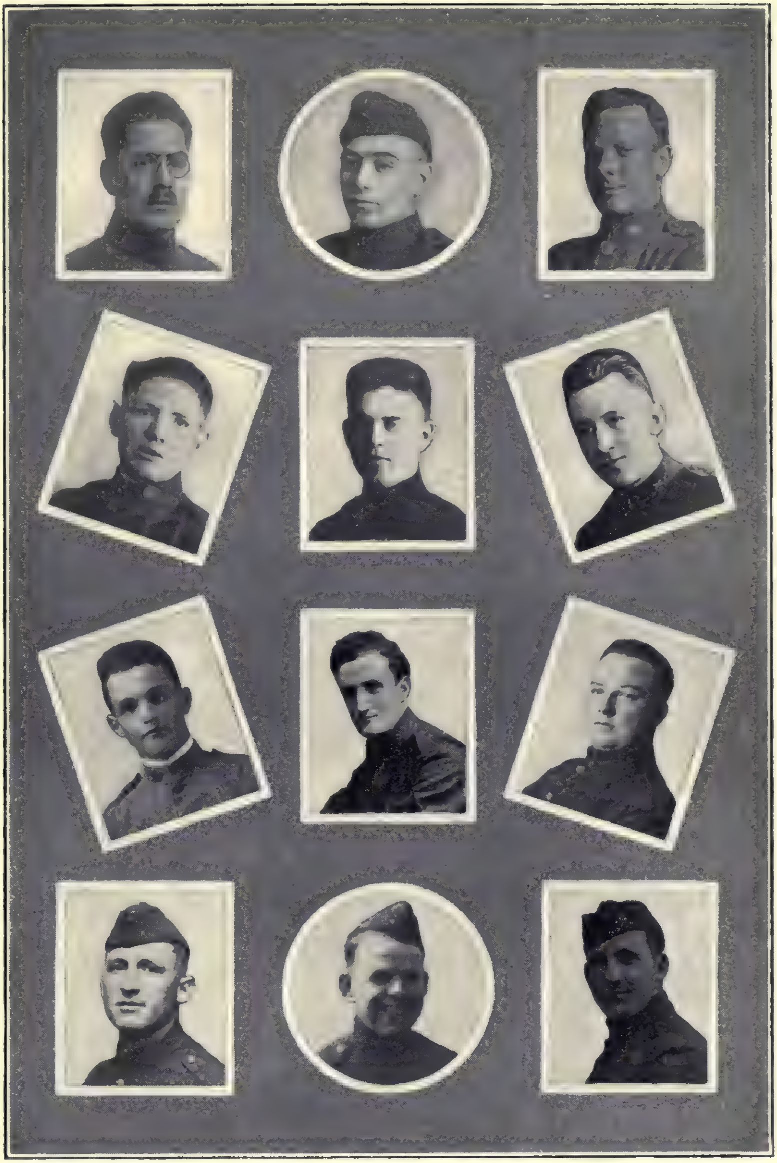
Niles Glass Division learned with sorrow of the death in action of Harmon Edward Whiteman. He was born in



Bernard P. Snee
Duke Rodgers
Everett W. Himeon
Roland S. Brown

Paul J. Jeffries
Roger F. Hartman
Louis F. Steen
Glenn E. Norton

Walter E. Briggs
Albert Cunningham
Ralph P. Mylechraine
John J. Stock



Fred A. Gregory
Patrick Murphy
Arthur H. Chiconi
William W. Cook

Roy P. Kaye
Anthony S. Greison
Walter A. Kelly
Percy A. Wentworth

Charles C. Kesler
Joseph E. Varnam
James Mahoney
Edward E. Rummell

Tiffin, Ohio, February 19th, 1895, and at the time he was called to the colors October 5th, 1917, was employed as a bulb gatherer at Niles. He was sent to Camp Sherman and in December, 1917, was transferred to Camp Sheridan, Alabama, where he was attached to Company L, 148th Infantry, 37th Division. He went to France with his Regiment and soon afterwards marched to the front. On November 3rd, 1918, while in action near the village of Heule, Belgium, he was wounded in the hip by shrapnel and died November 8th, as a result of these injuries. He was buried at Stadem, Belgium. Regarding his service, Major Roldon O. Nichols of the 148th Infantry wrote to Whiteman's sister:

"Captain Stewart of Company L, 148th Infantry, stated that your brother was a very good soldier and that he was wounded in action in Belgium on November 3rd, 1918, and had been removed to a field hospital, where he died. The captain did not know which hospital or where he had been buried. We simply receive a notice that our men who have been sent to the hospitals, which are far to the rear, have died and the cause of their death. Consequently it is very seldom that we know much more about it. Unless we are wounded and sent to a hospital it is very seldom we have even a chance to visit them.

"I inquired of the men of Company L, 148th Infantry, who had been intimately acquainted with him. Corporal Samuel Jenkins, Company L, 148th Infantry, stated that he had known your brother all the time he had been with the company and that he had been well liked by every man of the company and had been a very good soldier.

"Private Adolph Pequignot, Company L, 148th Infantry, stated that he had known your brother and had gone to a school of Gas Instruction for several days with him at 'Gits,' a small town in Belgium, just before our division went into battle in Flanders. Your brother qualified as an instructor in Gas and would have been made a non-commissioned officer in a short time. Pequignot stated that your brother was a very good soldier and was well liked by his comrades.

"Company L, 148th Infantry, was one of the companies that was the first to cross the Escaut River in Belgium on November 3rd, 1918. In the big combat the 37th Division was operating with the French Army. There were only two American Divisions assigned to the French Army operating in this part of Belgium, near Ghent, opposite Brussels.

"The 37th Division was the first to reach and cross the Army objective (the Escaut) and was farther advanced than any other organization operating with the French troops in this sector. I speak of this as you can readily understand the gallant, brave and spirited soldiers our American boys were and can be justly proud that your brother was one of them.

"Corporal Jenkins and Private Pequignot were with your brother at the time he was wounded and helped to take care of him. Harmon was wounded by shrapnel and was struck in the right hip.

"This occurred on the bank of the Escaut River, about 4:30 P. M. November 3rd, 1918, near the village of Heule, Belgium. These two men made a bed of straw for your brother and helped him all they could until he was sent back to the field hospital.

"The Germans were putting down at this time a very heavy artillery barrage and machine-gun fire. The artillery and machine-gun fire of the Boche was very heavy during the whole engagement and all of us suffered casualties.

"You have my heartfelt sympathy in the loss of your brother; but I trust you may be consoled in the thought that he was a brave and spirited soldier and died as a soldier for his country.

(Signed) R. O. NICHOLS
Major, 148th Infantry."

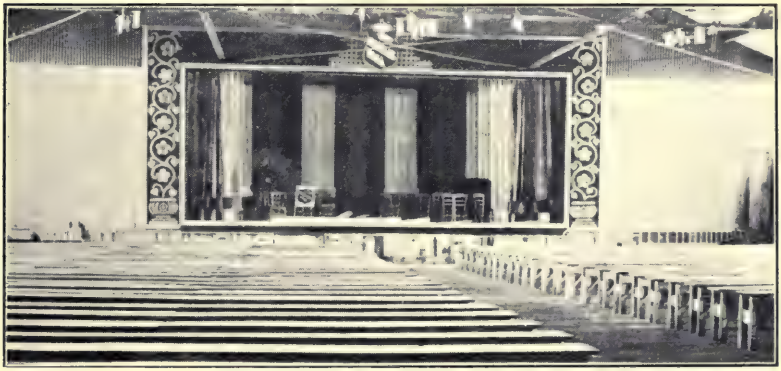
Private Patrick Murphy of the Euclid Glass Division was drafted May 28th, 1918. He was stationed for some time at Camp Gordon, Georgia, where he was attached to the 29th Company, Auto Replacement Regiment. In France, he was located in Chaumont with a Provisional Infantry Company which served as Guard of Honor for General Pershing at several decoration ceremonies. Murphy was discharged July 9th, 1919.

Walter A. Kelly, also of Euclid Glass, was drafted May 25th, 1918. He was ordered to Camp Gordon and later transferred to Camp Mills. In France, Kelly was attached to Company M, 18th Infantry, 1st Division, and saw action

YMCA
VICTORY THEATRE

Victory Theatre of the Y. M. C. A. at Bordeaux

Assignment to Quarters



Salvation Army Hut at Bordeaux

(The photographs appearing above were supplied by M. S. E., Hollis Townsend)

With the 37th Division—Olsene, Belgium

(The photographs on this page were supplied by Mrs. Rowlands, Engineering Department)

Infantry of 37th Division on Way to Front in the Toul sector, St. Mihiel, Argonne Forest and at Meuse-Argonne. He was discharged September 24th, 1919.

Battling Huns and Cooties

Two Youngstown Mazda men, Albert Handel and Walter Baeckler, went to France with infantry regiments. Handel entered service September 19th, 1917. He trained at Camp Sherman for three weeks and was then transferred to Camp Sheridan, Alabama. On May 1st, 1918, Albert embarked for France, where he took part in the following activities with Company B, 102nd Infantry, 26th Division:

(a) Seichprey Raid, Pos Fini sector, July 15th to July 18th, 1918.
(b) Marne defensive, July 15th to 18th.
(c) Aisne-Marne offensive, July 18th to July 25th.
(d) St. Mihiel salient, September 12th to September 16th.
(e) Troyon sector, September 17th to October 8th.
(f) Meuse-Argonne offensive, October 11th to November 11th.

Walter Baeckler was drafted into Company K, 316th Infantry of the 79th Division but later was transferred to Company E of the 112th Engineers, 37th Division. He admits that he went without a bath from October 27th to December 17th, 1918, and that in one battle with his enemy, the cootie, he counted twenty dead, with himself the only wounded.

Among the Central Falls Division infantry quota were Joseph P. Handrigan, Albert E. Bouvier and Everett W. Himeon. Handrigan had eighteen months' service in the Rhode Island National Guard before being drafted August 29th, 1918, so was well acquainted with military life. He was sent to Camp Upton, New York, where he was with the 1st Company, Army Service Corps. Arriving in England, Joe was stationed at Camp Knotty-Ash and Camp Winnell Downe. Handrigan had crossed the Channel to Le Havre and was about to leave for the front when hostilities closed.

Albert Bouvier was inducted June 24th, 1918, and trained at Camp Meade, Maryland, with a supply company of the 71st Infantry. He was assigned as a cook, and claims that his work about the furnaces at Central Falls was a great help to him. Himeon, who was a sealing machine operator, entered service October 3rd, 1917. He trained at Camps Devens, Gordon and Upton with Company C of the 326th Infantry, 81st Division, before going overseas. Himeon was billeted in France for some time, but saw no action along the front. He was discharged at Camp Upton, June 5th, 1919.

Lieutenant Bradford H. Kenyon, Superintendent of the Providence Base Works, entered military service April 27th, 1918. He spent his period of preparation at Camp Dix with the 310th Infantry, 78th Division, and then went overseas, being stationed in England for a brief period before going to France. Kenyon participated in the battles of St. Mihiel and Argonne. In 1919 he resumed his duties at the Base Works.

Attending the First Infantry Officers' Training School at Plattsburg, New York, Thomas E. Beatty, who towers six feet, one and one-half inches from the ground, was commissioned a second lieutenant and detailed to regimental or divisional headquarters work at Camps Wadsworth, Sherman, Gordon and Perry. At the time he was discharged, March 18th, 1919, he had been promoted to first lieutenant. Beatty later assumed a position with the Oakland Mazda Lamp Division.

Paul R. Hamrick, stock clerk of Lamp Equipment Division, was inducted April 1st, 1918. At Camp Sherman he was assigned to Company I, 332nd Infantry, 83rd Division, as a private. He went overseas from Camp Upton, New York, being stationed at Camp Standon, England, before going to France. Upon arriving on the continent Hamrick saw service in Metz as a sniper; was attached to Model Company at the 1st Corps Gas school, Gondrecourt, France; and still later was on duty in Luxemberg and Germany.

Niles Boy Killed in Great Defensive

One of the five Niles Glass Division boys to die in service was Harry Edward Peffer. He was small of stature, being five feet, three and one-half inches tall and weighing but one hundred and fourteen pounds. Harry left the employ of the Niles Division, where he was engaged as a gatherer, in July, 1917, and on July 5th enlisted at Columbus, Ohio, in the Infantry. He was sent to Camp Greene, North Carolina, where he was assigned to Company E of the 7th Infantry. He was later transferred to Company D, 9th Machine-Gun Battalion, with which outfit he saw action. Peffer was killed by shrapnel while participating in the Champagne-Marne Defensive, at about 8 o'clock on the morning of July 15th, 1918.

Under date of July, 1919, the following letter was sent to Harry's mother, Mrs. Emma Peffer, 336 Vine Avenue, Niles, Ohio, at the direction of the commanding officer of the 3rd Division:

"It is the desire of the Commanding General of this Division (Third Regular) that on this date, the anniversary of the great Champagne-Marne Defensive, one of the greatest battles of the World War, a letter be written to show the relatives of those who lost their lives on the field of battle, the great appreciation, esteem and devotion in which these men are held by the officers and soldiers of the organization in which they fought.

"Your son was killed in action on July 15th, 1918, during the Champagne-Marne Defensive, July 15th to July 18th, 1918.

"Inclosed you will find a certificate of Military History together with Victory Ribbon with appropriate stars denoting the several major operations.

"I take pleasure in advising you that recommendations have been forwarded to the Adjutant-General, recommending your son for the Distinguished Service Cross.

(Signed) A. H. INGOLD
Captain, 9th Machine-Gun Battalion."

Harry Peffer was but twenty-four years of age at the time of his death, having been born in Pittsburg, Pennsylvania, January 19th, 1894.

Patrick Griffin and John F. Drew of the Rhode Island Glass Division both enlisted June 24th, 1918. Griffin was sent to Camp Meade, Maryland, where he was attached to a depot brigade for a short time, later being transferred to Headquarters Company of the 71st Infantry, 11th Division. Drew was also ordered to Camp Meade where he rose to the rank of sergeant in the 7th Company, 154th Depot Brigade. He was discharged February 13th, 1919.

Loudon Boys Join 37th Division

Loudon Glass employees took a decided liking to the 147th Infantry of the 37th Division, for Hurley Potteiger, William F. Steinhurst and Joseph S. Merrick all enlisted in that regiment. All three saw action and two of them received wounds. Merrick was a carry-over boy before enlisting in the Army May 7th, 1917. At Camp Sheridan, Alabama, he was assigned to Company D, 147th Infantry, 37th Division. He was outfitted for overseas at Camp Lee, Virginia, and after landing in France participated in the Meuse-Argonne and Ypres-Lys offensives. In the Argonne skirmish, on September 28th, he was wounded in the left leg by a machine-gun bullet.

Hurley Potteiger enlisted December 28th, 1917, and was also in Company D. He embarked for France May 23rd and arrived at Brest July 5th. Hurley's fighting was done in the Alsace-Lorraine sector and at Ypres-Lys.

The third Company D boy, William Steinhurst, was employed by Loudon as a tube drawer. He enlisted January 21st, 1918, and was in the fray at Argonne Forest, St. Mihiel and the Ypres-Lys offensive, being wounded in the right knee by shrapnel October 30th, 1918. One thing which impressed Bill particularly was the solemn moments of prayer which the soldiers had by themselves as they were marching to and from the front, sometimes under hostile fire. "Addressing the man at your side, you would receive no reply and a few minutes later your pal would have the same experience when he would attempt to open up a conversation with you." Steinhurst was discharged April 19th, 1919.

The Niles Glass Division had an enviable infantry record. Eighteen were in this service and eleven saw duty overseas. One of these was Gower L. Beake who was attached to Company A of the 331st Infantry, 83rd Division, at Camp Sherman. He arrived in France on the 25th day of June, 1918. In August he was transferred to Company I, 119th Infantry, 30th Division, and on August 31st, he went over the top for the first time at Ypres, helping to hold the lines at that point until September 9th when his regiment was dispatched to the Hindenburg Line and succeeded in taking the towns of Ballicourt and Nauroy. Early in October the Americans captured the towns of Busigny, Vaux, Aubigny, St. Souplet,

Mont and Brancourt, while from October 16th to October 19th they took the towns of Molhain and Ribeauville. In all, Beake was over the top fourteen times, yet was never once wounded or gassed. He was discharged from service April 15th, 1919.

Arthur D. Gibbs, also of Niles, was drafted October 5th, 1917, into the ranks of the 83rd Division and was later transferred to the 6th Infantry Regiment of the 5th Division. He trained at Camp Sherman and Camp Forest, Georgia. On August 11th, 1918, while in France, he received honorable mention in dispatches for liaison work at Frappell, the first German town captured by the Americans. Gibbs was active in several raids, in one of which only twelve lads returned of seventy-five who went out. In the St. Mihiel sector he took shelter in a machine gun pit along with twelve other doughboys. Unfortunately, Fritz had the correct range and Gibbs was the only one not killed. He was internally injured, however, and suffered shell shock. Gibbs also informs us that he did six months' "compulsory service" with Pancho Villa in Sonora, Mexico, before the United States went into the war.

Two brothers, Charles H. Jones and Robert Jones, both of whom were employed by the Niles Glass Division, saw extensive service overseas. Charles was with Company H, 59th Infantry, 4th Division, and was overseas one year while Robert, who was with Company L, 54th Infantry, 6th Division, was in France thirteen months.

Jack C. Racey of the Cleveland Wire Division was connected with Headquarters Company, 164th Infantry, at Camp Gordon and while in France was located in a classification camp at St. Aignan. He was discharged April 27th, 1919.

The noblest sacrifice made in war is that of the man who falls on the battlefield with his face towards the foe. Such was the case with Frank Joseph Kearney of Niles, Ohio. Kearney was born in that city August 1st, 1884, and at the time he was inducted, September 26th, 1917, was in the service of the Niles Division as a gatherer. Sent to Camp Sherman, Kearney was assigned to Headquarters Company, 331st Infantry, 83rd Division, as a private. After a period of training at that camp he was sent to Fort Oglethorpe, then to Camp Gordon and later to Camp Merritt, where he was outfitted for overseas. Arriving in France, Frank was transferred to Company E of the 11th Infantry, 5th Division, and rose to the rank of sergeant. It was on the twelfth day of September, 1918, that Kearney met his death. While advancing under enemy fire in the St. Mihiel drive, he was struck by a German shell and instantly killed.

The National Lamp Works feels deeply the loss of this man for he was known to his associates as a conscientious and reliable worker, and every inch of his six feet of manhood was filled with the stuff that makes for true friendship and helpfulness.

Bulb Inspector Nick Catatto of the Euclid Glass Division was introduced to the pleasures of drill and guard duty March 16th, 1918. He was attached to Company M of the 50th Infantry and before being discharged, November 21st, 1918, had been stationed at Washington, D. C., and Camp Sevier, South Carolina.

Emilio Santoro of the Providence Base Works went to France September 1st, 1917, with the 26th Division. He saw action on eleven fronts, including Soissons, Toul Sector, Chateau-Thierry, St. Mihiel, Belleau Woods and Verdun. Carmelo Fotte, likewise of the Providence Base Works, sailed for France, June 14th, 1918, with the 116th Infantry of the 29th Division. He fought on several different fronts, being wounded and gassed. Fotte was discharged January 4th, 1919.

To be in a boat fired upon by a German submarine was the experience of Ernest J. Griffiths of the Niles Glass Division. Embarking for France August 26th, 1918, things progressed quietly on the voyage until September 6th, when a submarine appeared and fired upon the transport. The torpedo missed its aimed-for objective but struck a transport in the rear. The American submarine chasers in the convoy gave battle to the under-water boat and sank it. Griffiths was drafted October 6th, 1917, and assigned to the 27th Company, 7th Training Battalion, 158th Depot Brigade, at Camp Sherman. He was later transferred to Company M, 348th Infantry, 87th Division, at Camp Pike, Arkansas. Ernest was attending an officers' training school in France when the armistice was signed, and consequently saw no front-line action.

Lieutenant Samuel C. Thompson was on the roster of the 147th Infantry. He enlisted June 24th, 1916, and saw duty at Fort Bliss, Texas; Fort Benjamin Harrison, Indiana, and Camp Sherman. Upon being discharged, December 17th, 1918, he was employed by the Trumbull Mazda Lamp Division.

Over the Top at St. Mihiel A National man experiencing the many thrills which army life had to offer was William G. Hilling, who previous to his induction was employed by the Cleveland Wire Division. He became a soldier of the 83rd Division November 13th, 1917, and was sent to Camp Sherman and attached to a supply company of the 331st Infantry. Finishing training there, he was transferred to Camp Merritt, outfitted for overseas duty and sent to France. Arriving on the other side, Hilling was transferred on July 29th, 1918, to the 26th Division and then began an active participation in the war which he will long remember. At Chateau-Thierry he was assigned with support troops, but in the St. Mihiel drive he went over the top with the doughboys. He was also in the Argonne Forest drive and in this offensive was made a runner. Bill was shelled twice while carrying messages, and on October 26th, 1918, was severely wounded by a German shell and was removed to Base Hospital No. 13 at Limoges. Recovering from the wounds, he rejoined his company. Hilling was discharged from service April 28th, 1919.

James B. Burns of the Niles Glass Division was another of National's men who was incapacitated by wounds received in battle. Detailed with Company M of the 315th Infantry, 79th Division, at Camp Meade, Maryland, he went to France with the same regiment and took part in the action at Verdun. In that encounter two fingers and a part of his hand were shot off, rendering him unfit for further service. He was discharged from the army April 22nd, 1919.

Pneumonia was fatal to six of National's service men. Among this number was Enoch Edward Brooks, who had been a bulb gatherer with the Niles Glass Works. He was born in Youngstown, Ohio, on the 28th day of December, 1895, and enlisted about August 13th, 1917, in Youngstown as a private in Company L, 38th Infantry, 3rd Division. During the seven and one-half months he served his country as a soldier, Enoch had been stationed in Syracuse, New York; Columbus Barracks, Columbus, Ohio; Camp Greene, North Carolina, and Camp Merritt, New Jersey.

He was at Camp Merritt when stricken, passing away in the camp hospital on April 3rd, 1918.

"They never fail who die
In a great cause."
(*Byron.*)

Herbert C. Masonbrink, a machinist with the Lamp Equipment Division, enlisted May 25th, 1918, in the 47th Infantry of the 4th Division, then located at Camp Gordon. Upon arriving overseas he was sent to the training area at Larave, France. After some time along the Flanders front the regiment was transferred to the Verdun sector, where Masonbrink went over the top five times. In the Argonne Forest Masonbrink and one other soldier volunteered to get water during a heavy shell fire, and while on the trip his canteen and right coat pocket were shot off. Shortly afterwards, in an adventure over the top, Masonbrink was hit seven times. He was sent to a hospital on the Mediterranean, where he received treatment for four weeks. After another month in a hospital at Bordeaux, Masonbrink received transportation to the United States.

Georgia, France and Germany

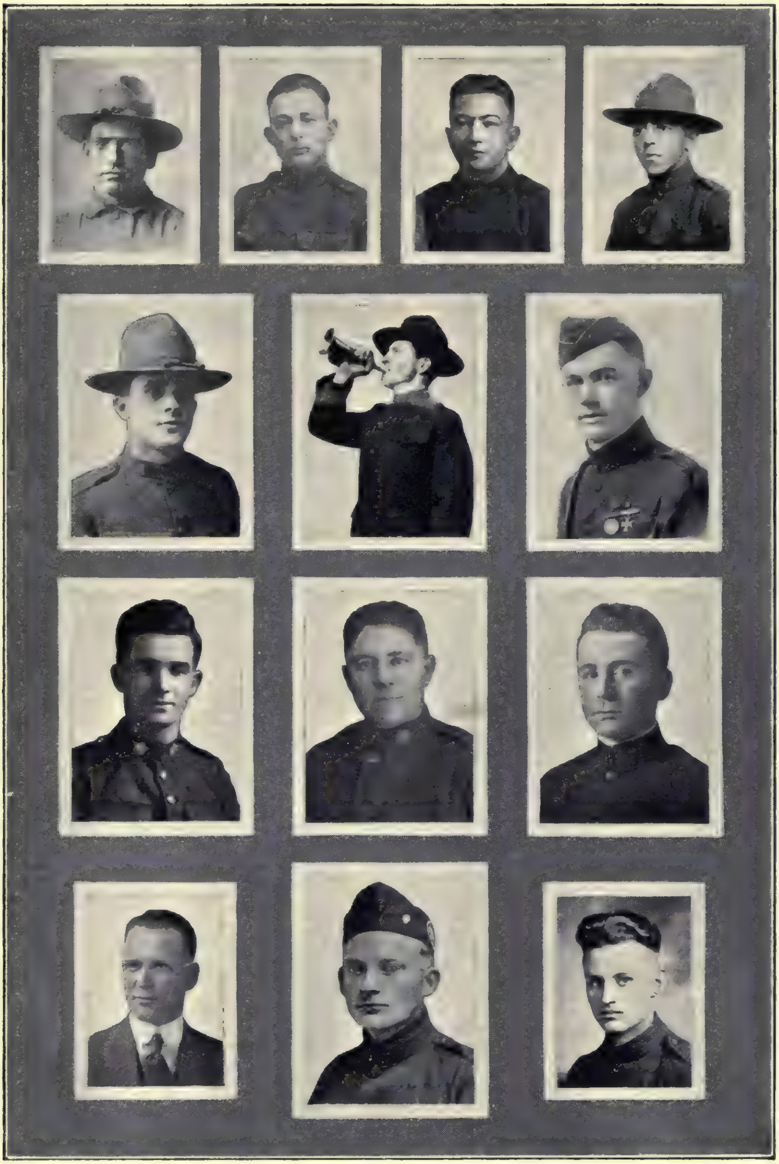
Twenty-six months' service gave David O. Firm an intimate knowledge of army life and ways. He was inducted May 25th, 1917, and soon entrained for Camp Gordon, Georgia, where he was placed on the roster of Company D, 47th U. S. Infantry, 4th Division. Upon arriving in France, his first taste of action was experienced at Tuleon, from September 6th to September 10th, 1918. He also participated in the following engagements:

St. Mihiel offensive, September 12th to September 14th.

Meuse-Argonne sector, September 26th to October 18th.

After the armistice was signed, Firm was lucky enough to be with a regiment which was detailed to move with the American Army of Occupation into Germany. He was in that country from December 15th, 1918 to July 11th, 1919. On August 4th, 1919, he was discharged from the army and returned to the Euclid Glass Division where he resumed his work as bulb blower.

A Euclid Glass boy who went overseas was Robert J. Walters. He was inducted May 27th, 1918, and sent to Camp



Emilio Santoro Harry McElhaney Charles Mahoney Ovide L. Barry
Raymond B. Littlefield Selden G. Hill Luke P. Wolfford
Richard Molloy Philip P. Smoots Raymond Leonard
James C. Lindsay Hugo Johnson Joseph Potter

John Russell — Charles J. Motto — John J. Lyons

Oscar E. Johnson — Earl T. Martin — Fred Colcord

Fred J. Gilmour

Norman A. Brown — Raymond E. Purser — Charles O'Grady

Dennis Foley — Raymond Mentz — Emil Teschke

Gordon, where he was placed in the 32nd Company, 3rd Replacement Regiment. After a short period of training there he was transferred to Camp Merritt and then embarked for overseas. Arriving in England, he was for some time at Camp Knotty-Ash, Liverpool, and Camp Winnell Downe, Winchester. Crossing to France, his time was spent at three places, the American Replacement Camp at Saint Aignan, in the Noyon sector; Camp La Valbonne and Camp Ain. He was in an infantry casual section and saw no action along the front. Walters was discharged June 6th, 1919.

The name of Noble Calven Lintz appears on the list of National men killed in action. He was born March 23rd, 1896, and at the time he was drafted, January 21st, 1918, was in the employ of the Detroit Miniature Lamp Division, doing clerical work. He entered service in Warren, Ohio, and was sent to Camp Sherman, where he was assigned to the 4th Company, 331st Infantry, 83rd Division. He went to France with that Division but was apparently transferred to another, for the 83rd saw no active service on the front. We were unable to obtain detailed information as to the sector in which he was operating when he lost his life, learning only that the supreme sacrifice was made July 21st, 1918. Noble was but a stripling, for though five feet, nine inches in height he weighed less than one hundred and ten pounds. His lack of weight, however, was amply overbalanced by his courage and by his deeds he showed himself worthy of the name he bore.

Smoots Crosses Into Germany One of the many National men who served in the Army of Occupation was Phillip P. Smoots a tube-coverer employed by the Euclid Glass Division. He was of the far-famed 2nd Division, operating with the 23rd Infantry in several drives. He was drafted October 2nd, 1917, and his period of training in the United States was spent at Camps Sherman, Merritt and Pike. Smoots arrived in France July 11th, 1918, and subsequently took part in the battles of Champagne, St. Mihiel and Meuse-Argonne. The company of which he was a member suffered 192 casualties in the battle of Champagne. From December 22nd, 1918 to July 16th, 1919, he was in German territory and four weeks of that period was spent in a hospital at Vallendar, recovering from influenza. He returned to this country early in August, 1919, and was discharged on the 14th day of that month.

The privilege of overseas service was denied to many men, some of whom even had to forego the honor of an extensive period of home training. John M. Doyle, due to no fault of his own, was in the latter class. Inducted May 28th, 1918, he was called to Camp Gordon and assigned to Company B of the 3rd Infantry Replacement Regiment. He was promoted from private to acting sergeant, but after two months of field work was sent to the base hospital, and on August 28th, 1918, was honorably discharged from service because of defective eyes. He returned to the Cleveland Wire Division in the capacity of draftsman.

The first National man to meet with a fatal accident in military service was Robert Temple Coughlin. He enlisted May 7th, 1917, in the Cleveland Grays, which outfit upon arriving at camp became known as the 148th Infantry. Coughlin was born February 1st, 1898, in a small town in Massachusetts but early came to Cleveland and at the time he entered service was employed in the laboratory of the Cleveland Wire Division. With his company he went to Camp Sherman and later to Camp Sheridan, where he met his death October 17th, 1917. Uncle Sam lost a splendid prospective fighter in Coughlin, for Robert gave every inch of his six feet and every ounce of his two hundred and forty pounds to the cause in which he so early enlisted. At the time of his death he was ranking as corporal.

The writer regrets that complete information on all of those who died in service was not obtainable, for to them especially we all owe the greatest respect and homage. One of those who met death in action and concerning whom we were unable to learn full details was George Charles Clancy. He was born in Fostoria, Ohio, October 23rd, 1893. He came to Cleveland, and at the time he was called to serve his country was employed by the Euclid Glass Division as a bulb gatherer. On October 5th, 1917, he went to Camp Sherman, and like the hundreds of thousands of untrained civilians who went zealously and gladly about their duty, he soon became a well trained and excellent soldier. Clancy was attached to Company D, 16th Infantry, and after intensive training he was transferred to Camp Pike, where he received further drill and preparatory work. From Camp Pike he went to

Camp Merritt and then overseas. At this point our information ceases, except that on October 9th, 1918, he was killed in action. Clancy had served his country one year as a soldier, and his memory will ever bring to the minds of friends and associates the lad who was as thoroughly conscientious in his tasks as a civilian as he showed himself to be as a boy in khaki.

Sergeant Joseph E. Varnam was called to the army from Cleveland, October 2nd, 1917. With a contingent of drafted men he was sent to Camp Sherman and assigned to Company G, 331st Infantry. When the 83rd Division sailed for France, Joe was left behind and assigned to a headquarters company at Camp Merritt, New Jersey. He remained at that camp for over a year, being discharged June 28th, 1919. Returning to Cleveland, he resumed his place as a draftsman with the Cleveland Wire Division.

Among the many National factory men in the 331st Infantry, 83rd Division, was Floyd M. Larremore of the Euclid Glass Division. He went to Camp Sherman upon being drafted September 9th, 1917, and was attached to a supply company. He was later transferred from Camp Sherman to Camp Merritt. Upon arriving overseas, Larremore was assigned to a Quartermaster Detachment of the Third Army Corps. Among his duties were trench digging and work on the construction of an officers' training school. He ranked at this time as sergeant; he was discharged July 23rd, 1919.

Another man dying in service and concerning whom full information was not available was William A. Wilcox, paymaster of the Euclid Glass Works. Upon entering the army Wilcox was sent to Camp Gordon, Georgia; from which camp he went overseas. In France he was assigned to the Military Specialist Company, Clerk School, at St. Aignan. It was at this camp that Wilcox was taken ill, dying in December, 1918, of pneumonia.

Charles M. Klock, later employed by Lamp Equipment Division as a screw-machine operator, was voluntarily inducted September 8th, 1917, at the age of twenty years. He trained at Camps Sherman, Pike, Greene and Mills until May 9th, 1918, when he embarked for France. Taking part in the action at Chateau-Thierry, he was gassed August 5th, 1918, and removed to an army hospital where he was under care for six months. Klock returned to the United States October 12th, 1919, and was discharged five days later.

Below are the names of certain other National factory men who were in the Infantry, and concerning whom we have only limited statistical data. The complete list will be found in the Roll of Honor, on page 147. We have listed the date of entering service, date of discharge, company to which they were attached and the camps at which they were stationed:

Herman Glave—Cleveland Wire Division. 33rd Company, 9th Training Battalion, 158th Depot Brigade, August 30th, 1918 to December 2nd, 1918; Camp Sherman.

William Lane—Cleveland Wire Division. Headquarters Company, Depot Brigade, April 30th, 1918 to April 10th, 1919; Camp Sherman.

Lloyd Sibert—Cleveland Wire Division. 36th Company, 9th Training Battalion, 138th Depot Brigade, April 26th, 1918 to December 16th, 1918; Camp Sherman.

John C. Snouffer—Euclid Glass Division. 5th Company, 2nd Training Battalion, 158th Depot Brigade, September 5th, 1918 to October 8th, 1918; Camp Sherman.

Francis C. Metzger—Lamp Equipment Division. Infantry; later Field Artillery Officers Training Camp, May 27th, 1918 to December 1st, 1918; Camps Gordon and Taylor.

Walter F. Merrick—Loudon Glass Division. Company D, 8th Battalion, United States Guard, April 1st, 1918 to January 1st, 1919; Camps Sherman and Devens.

John R. Gilbert—Miniature Bulb Division. Infantry Casual Section, May 26th, 1918 to December 17th, 1918; Camps Lee and Stuart.

Joe Silvarolo—Miniature Bulb Division. 36th Regiment, April 28th, 1918 to December 6th, 1918; Camps Sherman and Sheridan.

George H. Brooks—Niles Glass Division. Company A, 348th Infantry, 87th Division, September 20th, 1917 to March 22nd, 1919; Camps Sherman, Pike and Dix.

John F. Connor—Niles Glass Division. Company L, 78th Infantry, 14th Division, August 29th, 1918 to January 21st, 1919; Camp Custer.

Raymond A. Dunnigan—Niles Glass Division. 331st Infantry, 83rd Division, September 7th, 1917 to February 8th, 1919; Camp Sherman.

John A. Krizen—Niles Glass Division. Company I, 165th Infantry, 42nd Division, November 1st, 1917 to March 18th, 1919; Camps Sherman and Pike.

Andrew Monahan—Niles Glass Division. Company 18, 159th Depot Brigade, August 28th, 1918 to December 10th, 1918; Camp Taylor.

James E. Ryan—Niles Glass Division. Company D, 380th Infantry, September 5th, 1918 to December 13th, 1918; Camp Sherman.

Robert J. Williams—Niles Glass Division. 9th Company, 1st Replacement Regiment, May 26th, 1918 to April 30th, 1919; Camps Gordon and Merritt.

Second Lieutenant Paul A. Holt—Ohio Division. Headquarters Company, 331st Infantry, 83rd Division, September 21st, 1917 to March 14th, 1919; Camps Sherman, Lewis and Lee.

Joseph M. Mitrovitch—Ohio Division. 9th Company, 1st Replacement, 3rd Regiment; later Company A, Developing Battalion No. 1, May 26th, 1918 to December 18th, 1918; Camp Gordon.

Raymond E. Purser—Ohio Division. Overseas. Company 3, 332nd Regiment, 83rd Division; March 27th, 1918.

William K. Titus—Ohio Division. 35th Company, 9th Training Battalion, 158th Depot Brigade, September 2nd, 1918 to February 20th, 1919; Camp Sherman.

Wilbert Yoakam—Ohio Division. 32nd Company, 8th Training Battalion, March 25th, 1918; Camp Sherman.

Lawrence W. Stark—St. Louis Mazda Lamp Division. Company C, 7th Battalion, 3rd Regular Infantry, July 15th, 1918 to December 18th, 1918; Camps MacArthur and Funston.

H. S. Lea—Trumbull Mazda Lamp Division. Company D, 145th Infantry, 37th Division, July 19th, 1917; Camp Sheridan. Went to France where he saw action.

Roy W. Smith—Trumbull Mazda Lamp Division. 331st Infantry, 83rd Division, Camp Sherman. Had six months duty in France.

THE ARTILLERY

Field Artillery The Field Artillery was a big "drawing card" among the men from the Manufacturing Divisions of National, and several of those enlisting in this branch of the service went through the thick and thin of several campaigns. S. Emil Michelson of the Youngstown

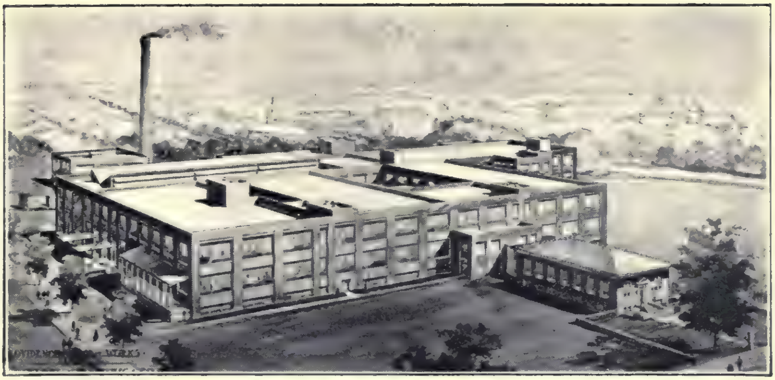
Mazda Division enlisted December 14th, 1917, in the 136th Field Artillery, 37th Division. He was sent to Camp Sheridan and, after receiving preliminary training there, was shipped to France, where he spent fifty-two days with his regiment in the Marbache sector and in the Meuse-Argonne offensive. He ranked as a musician, first class.

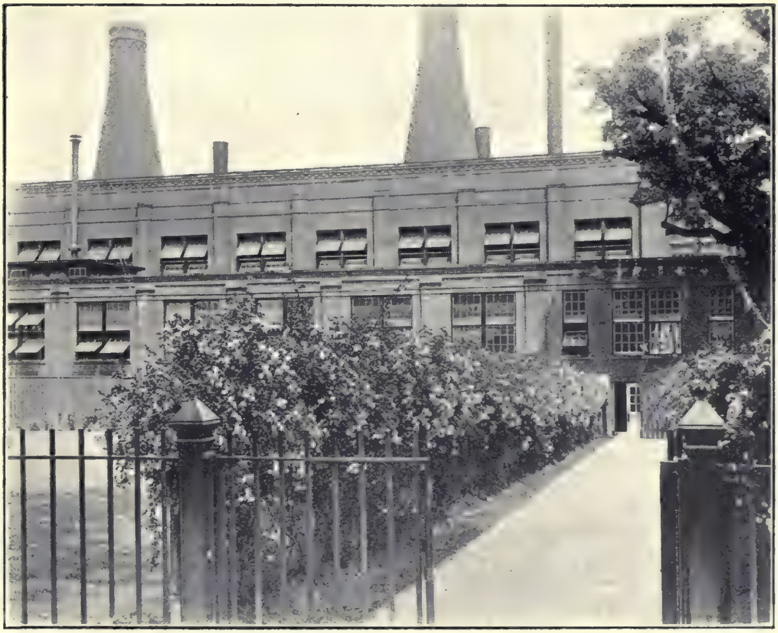
Floyd C. Marshall of the Providence Base Works entered service August 5th, 1917, with Battery A, 103rd Field Artillery. He arrived in France October 23rd, 1917, and in November of the same year was commissioned a second lieutenant, which rank he held until April 30th, 1918, when he was given a first lieutenancy. As an officer of Battery A, 103rd Field Artillery, and later Battery A, 6th Field Artillery, 1st Division, Marshall saw action in the following engagements: Toul sector, Montdidier, Noyon defensive, and the offensives of Aisne-Marne, St. Mihiel and Meuse-Argonne. In December, 1918, he moved with the Army of Occupation into Germany, remaining there until August 15th, 1919.

D. Courtenay Woodman of the Puritan Refilled Lamp Division enlisted June 5th, 1917, in the medical detachment of the 102nd Field Artillery, 51st Brigade, 26th Division. After training at Camp Curtis Guild, Boxford, Massachusetts, he went to France, being located at St. Nazaire and Camp Coetquidon before going into an active sector. He remained on the Front from February 3rd, 1918 until the signing of the armistice, seeing action during this period in the Chemin de Dames sector, north of Soissons; Toul sector; Battles of Seichprey and Xivray; and in the offensives of Aisne-Marne, St. Mihiel and Meuse-Argonne. Woodman was never absent from duty during his period of army service nor did he receive a scratch to show he had been in the midst of terrific action.

Enlisting May 26th, 1917, in the Ohio Cavalry, which was later merged into the ranks of the 37th Division as field artillery, Rowland E. Larkman, Jr., was mustered into service at Camp Sheridan. He went to France with Battery C of the 135th Field Artillery, seeing action at St. Mihiel, Argonne, Marbache, Troyon and Thiaucourt. He was discharged April 11th, 1919, and was re-employed by Cleveland Mazda.

Earl T. Martin, office manager of the Illinois Miniature Lamp Division, had twelve months' home service and four months' overseas in the heavy field artillery. He was inducted





Upper Photo—Providence Base Works, Providence, R. I.

Lower Photo—Rhode Island Glass Division, Central Falls, R. I.

Puritan Refilled Lamp Division, Providence, R. I.
(This Division was located at Danvers, Mass., during the war.)

E. 152nd St. Properties, Cleveland, including Euclid Glass Division

September 19th, 1917, and was stationed at Camps Grant, Robinson and Mills. The most noteworthy experience of his army life was a march from Camp Grant, Illinois, to Camp Robinson, Wisconsin, a distance of about 225 miles. The destination was reached after fifteen days of strenuous hiking, and though the boys did not enjoy the hardships of the march any too well, they later realized it had done them a world of good, especially after they arrived in France. William J. Reed, likewise of the Illinois Miniature Lamp Division, was attached to Headquarters Company, 7th Field Artillery Regiment. During his army career, lasting from June 15th, 1918 to December 26th, 1918, he was stationed at Valparaiso, Indiana; Indianapolis and Camp Taylor, Kentucky. For six weeks he was suffering with influenza in an army hospital.

Joseph Cardinale and John Hagan entered service from the Providence Base Works. Cardinale trained at Camp Slocum from June to August 1st, 1917, when he went to France with the 7th Field Artillery Headquarters Company. He saw action at Montdidier, where he was wounded and gassed, Toul, Argonne and Soissons. Hagan joined the ranks June 5th, 1918, being at New York University Training School for two months and at Camp Jackson, South Carolina, with a Field Artillery Regiment, for seven months.

From bulb gatherer to cook was the record of Nick Petosky of the Euclid Glass Works. He enlisted June 4th, 1917, and was assigned to Battery A, 11th Field Artillery, at Camp Harry J. Jones, Arizona. Later, he was transferred to Fort Sill, Oklahoma, and then to Camp Mills, Long Island. Nick was discharged July 18th, 1919.

A fellow workman of Petosky's, Elmer A. Kaye, also enlisted in the 11th Field Artillery and was assigned to Battery E. Elmer was located at the same camps and upon arriving overseas saw action in the Meuse-Argonne offensive from September 26th to November 11th, 1918. He was discharged July 6th, 1919.

Attention, stout people! Here the army is suggested for those who desire to lose weight. Theodore A. Just, who in civil life tips the scales around one hundred and sixty-five pounds, admits that while under the care of the army drill officer and mess sergeant he reduced to one hundred and forty-eight pounds. As Ted was only five feet three and one-half inches tall he must have felt greatly indebted to Uncle Sam, especially on hot days. Just was drafted May 16th, 1918, and trained at Camp Jackson, South Carolina. He was attached to Battery B of the 73rd Regiment and upon being discharged, January 9th, 1919, was employed by the Welds Division.

Roland S. Brown of the Providence Base Works enlisted in the Coast Artillery, but after training at Camp Devens was sent to France with Battery E of the 55th Field Artillery. His regiment arrived at Le Havre April 8th, 1918. After travelling two days and a night in a cattle car, the boys reached their destination, where intensive training was the program for three months. Brown was sent to the front July 25th, and on August 2nd went into action at Chemin-des-Dames. In this drive the Germans were driven back about thirty miles. Other engagements in which Brown saw service were:

Second Battle of the Marne, August 2nd to August 18th, 1918.

Operation on the Vesle, August 18th to September 8th.

Meuse-Argonne offensive, September 26th to November 11th.

Brown ranked as a corporal, and was discharged February 9th, 1919.

Three Italian boys of the Providence Base Works were attached to Field Artillery regiments. Savior Giovannucci entered service in Paterson, New Jersey, May 27th, 1918. He was ordered to Camp Dix, where he was assigned to Battery D of the 334th Field Artillery, 87th Division. Giovannucci went to France, where he was stationed for some time at Bassens. Ernest Borrelli, who was later employed by the Providence Base Works as a foot-press operator, was located at Camp Devens with Battery F, 301st Regiment, 76th Division, while Vincenzo Sincero was attached to Headquarters Company of the 336th Field Artillery, 87th Division. He received his training at Camps Upton, Dix and Merritt, being discharged March 18th, 1919.

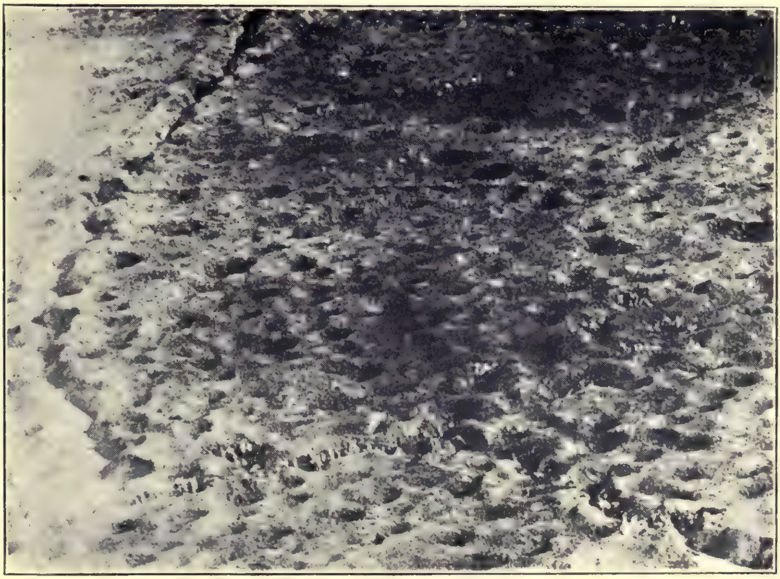
E. Neale Derry, an assistant foreman of the Central Falls Mazda Lamp Division, enlisted May 10th, 1917, in Battery A of the 103rd Field Artillery, 26th Division. After learning the fundamentals of artillery operation at Boxford, Massachusetts, Derry went to France where he was stationed for some time at Camp Coetquidon.

A Captured German Tank in France
(Photograph furnished by Mr. F. S. Terry)

American Port at Bassens, France
(Photograph furnished by M. S. E., Hollis Townsend)

Germans waiting for the Yanks at Argonne Forest (an Airplane Photo)

(The photos on this page furnished by M. S. E., Hollis Townsend)



Hand-to-Hand Fighting in Trenches near Chateau-Thierry
(An Airplane Photo)

Euclid Glass Worker in Many Battles

Probably few, if any, National men saw more active service than Roy P. Kaye, a tube worker with the Euclid Glass Division. He enlisted in Cleveland June 1st, 1917, and went to Camp H. J. Jones, Douglass, Arizona, where he was assigned to Battery A, 10th Field Artillery, 3rd Division. His overseas record reads as follows:

(a) Chateau-Thierry, July 10th to July 14th, 1918.
(b) Champagne-Marne defensive, July 15th to July 18th.
(c) Aisne-Marne offensive, July 18th to August 1st.
(d) St. Mihiel offensive, September 12th to September 16th.
(e) Meuse-Argonne offensive, September 26th to November 11th.

Kaye was recommended by the battery commander for the Distinguished Service Cross for bravery under shell fire in the Argonne sector, north of Verdun. He was discharged August 30th, 1919, and returned to the Euclid Glass Division.

Three Niles Glass boys spent considerable time in the Artillery. Elmer G. Keiser started out July 24th, 1918, with Battery B of the 6th Regiment of Field Artillery, and was later put on military police duty. He was stationed at Camp Jackson, South Carolina. Frank R. Finnigan was inducted August 28th, 1918. He was assigned for a short time with the 18th Company, 5th Battalion, 159th Depot Brigade at Camp Taylor, and was then transferred to Battery B of the 2nd Field Artillery. John H. Ziegler enlisted May 21st, 1918, in the 312th Cavalry and was then transferred to Battery F of the 61st Field Artillery. He was on duty at Fort Russell, Camp Jackson and Camp Sherman.

Coast Artillery

Among the many boys in this branch of the service was George Washington Williams, later with the Niles Glass Division. He was inducted April 2nd, 1918, and assigned to the Coast Artillery. On July 15th he was sent overseas with the 70th Regiment. Williams never had a chance to dodge dum-dum bullets, but spent several months back of the lines, drilling. George L. Carter, also later employed at the Niles plant, enlisted March 3rd, 1918, and was sent to Fortress Monroe, Virginia. At the date of discharge, December

7th, 1918, he was with an auto detachment at the Coast Artillery School.

Sven O. Lindblom, a machinist with the Providence Base Works, enlisted December 15th, 1917, with the 21st Company at Fort Wetherill, Rhode Island, and was later transferred to Battery F, 66th Artillery at Fort Adams. He saw service abroad at Camp Knotty-Ash, Liverpool, England; Morne Hill, Winchester, England, and Nexon and La Courtine, France. Sven was discharged March 20th, 1919.

Another coast-artilleryman was Ovide L. Barry of Rhode Island Glass. He embarked for overseas July 19th, 1918, after training at Fort Slocum, New York; Fort Greble, Rhode Island, and Fort Adams, Rhode Island. On the trip across the transport was attacked by a submarine, which the gunners fired upon and are believed to have sunk. While in England, Barry witnessed an air raid in which an enemy machine was shot down.

Fred B. Owen, foreman of the breakage department of the Oakland Mazda Lamp Division, enlisted March 18th, 1918, in the Coast Artillery as a private. He was assigned to Fort Scott, California, but was later transferred to Fort Monroe, Virginia, where he earned his commission as second lieutenant. He was discharged from service August 22nd, 1919.

For Work Well Done

Inducted December 18th, 1917, William H. Broadbent of the Euclid Glass Division was ordered to Jackson Barracks, New Orleans, and assigned to the 314th Company of the Coast Defense. He was transferred to the 64th Regiment and still later to the 59th Coast Artillery Regiment, with which outfit he saw action in France. On November 1st, his battery received the following commendation:

"The Brigade Commander wishes to express to you his high appreciation of the excellent service rendered by yourself, and the officers and men of your command, in connection with this Brigade in the Artillery preparation and support of the action of November 1st, 1918 (the Meuse-Argonne). Your work has been done promptly and well, and it has been a pleasure to have you with the Command."

On November 20th, 1918, the following citation was announced from headquarters of the Fifth Army Corps:

"The 59th Regiment of Coast Artillery while under the command of the 5th Army Corps, during the Meuse-Argonne operation, worked in close co-operation with the Divisional artillery, delivering effective destructive fire on objectives.

(Signed) C. P. SUMMERALL,
Major General, Commanding."

Broadbent was discharged February 11th, 1919.

Among the Niles boys in service was Joe Vecchione, who entered service May 18th, 1918, in Battery E of the 45th Coast Artillery, and was later transferred to the heavy artillery. He was with the American Expeditionary Forces in France from October 20th, 1918 to February 19th, 1919.

Howard H. Murphy of the Euclid Glass Division was called into the army December 18th, 1917, and assigned to Battery E, 75th Coast Artillery, at Jackson Barracks. Other camps at which Murphy trained were Fort St. Phillips and Camp Nichols. When he was released from service, March 31st, 1919, Howard was with the 10th Infantry Training Battalion at Camp Nichols.

Several other National men were in the Coast Artillery. Joseph Lemaire of the Rhode Island Glass Division enlisted May 23rd, 1917, as a cook in the 22nd Regiment. For some unknown reason he was transferred from the kitchen and made bugler. Perhaps the reader can solve the problem. At any rate Joe served honestly and faithfully, and his eighteen-months' service record shows his character excellent. Raymond B. Littlefield, later of Rhode Island Glass, ranked as sergeant-major. He enlisted May 23rd, 1916, and after training at Fort Kearney, Rhode Island, and Camp Lee, Virginia, went overseas, where he was stationed for three months, from September to December, 1918.

Fred R. Edmonds, later of the Miniature Bulb Division, enlisted May 2nd, 1917. He was stationed at Fort Thomas, Kentucky; Fort Washington, Maryland; Fort Hunt, Virginia, and Camp Stuart, Virginia. Edmonds went overseas with the 60th Regiment and was active in the following sectors:

St. Mihiel, September 11th to September 15th, 1918.

Meuse-Argonne, September 26th to November 11th.

He was employed by the National as an automatic bulb-machine operator.

Railroad Artillery Herbert L. Anderton of the Rhode Island Glass Division enlisted in the 43rd Regiment of the Railroad Artillery, November 22nd, 1917. After training in several camps in this country he was ordered overseas July 28th, 1918. On the trip across, two enemy submarines were sunk by destroyers which were escorting the convoy. Anderton remained in France six months, arriving at Camp Upton for discharge January 3rd, 1919.

MACHINE-GUN

A "triple play," from officer candidate to captain to major, was the record of Luke P. Wolfford who at the time of his enlistment was office manager for the Cleveland Wire Division. Attending the First Officers' Training Camp at Fort Benjamin Harrison, Wolfford was commissioned captain August 17th, 1917. He was assigned as Commanding Officer of the 323rd Machine-Gun Battalion at Fort Sill from October to December of the same year, and was then transferred to the 83rd Division as auto rifle instructor. In June he took the machine-gun company of the 330th Infantry to France, and from July 1st to November 11th, 1918, he was training troops near Le Mans, France. On September 3rd, Wolfford was promoted to major. The period between December, 1918, and April, 1919, was spent commanding the 130th Battalion, Military Police Corps, and from April to June, Wolfford instructed at the American Expeditionary Force University. He was discharged from the army July 7th, 1919.

Louis F. Steen, later employed as a clerk by the Rhode Island Glass Division, enlisted April 28th, 1917, in the Cavalry but on August 5th was transferred to a machine-gun detachment and went overseas October 3rd, 1917, with the 103rd Battalion of the 26th Division, participating in the following engagements:

Soissons, February, 1918.
Chemin-des-Dames, March, 1918.
Apremont, Toul sector, April, May and June, 1918.
Chateau-Thierry, July, 1918.

Steen was wounded at Chateau-Thierry July 20th, 1918, being struck below the knees with machine-gun bullets. He returned to the United States January 3rd, 1919.

Roger F. Hartman of the Puritan Refilled Lamp Division was inducted October 5th, 1917. He was mustered into

Company B of the 320th Machine-Gun Battalion, 82nd Division, and trained at Camps Devens, Gordon and Upton. Roger then went overseas, where he saw action on five fronts. He was gassed October 14th, 1918, while taking part in the Argonne Forest drive. This misfortune held him in the hospital four months.

Six-footer Dennis D. Foley of the Rhode Island Glass Division enlisted June 24th, 1918, and was assigned to Company D of the 32nd Machine-Gun Battalion at Camp Meade, Maryland, while Uhl M. Smith of the Youngstown Mazda Lamp Division enlisted June 14th, 1917, in the 135th Machine-Gun Battalion. He was assigned to Company C as a private. After training with his outfit at Camps Sheridan and Lee, he was transferred to the Searchlight Investigation Section of the army, at Washington, D. C., where he ranked as master engineer, senior grade.

A Cleveland Wire Division boy, Richard A. Molloy, enlisted February 6th, 1918, in the Canadian Infantry. Upon receiving fundamental drill work at St. Thomas, Ontario, Canada, he was ordered to England, where he was assigned to the 3rd Canadian Machine-Gun Battalion. Further training was given Molloy at Bramshott and Seaford before he was prepared to face the German music. After arriving in France he saw action at Amiens, Arras and Cambrai. Molloy's only comment on the war was to say that it was very amusing — quite droll, in fact.

Evald Gustafson of the Euclid Glass Division was drafted November 28th, 1917, and sent to Camp Sherman, where he was attached to Company C of the 322nd Machine-Gun Battalion, 83rd Division. Arriving in England Gustafson was transferred to the 106th Battalion of the 27th Division and saw service with that regiment in France. Much of Evald's time was spent in Le Mans.

ENGINEER CORPS

Ten factory men affiliated with the Engineer Corps went overseas and participated in active sectors. Ward F.

Martin of Nela Lamp Division enlisted May 5th, 1917, with the 112th Engineers, 37th Division, and after training at Camps Sheridan and Lee went overseas. He saw service at St. Mihiel, in the Vosges Mountains, Argonne Forest and along two Belgian fronts. During the Argonne Forest drive Martin's company lived in a dugout four days before they discovered two Germans who had been hiding in that very same dugout. The Germans had concealed themselves by digging a hole in the wall of the dugout; after crawling into this hole they had faced the opening with a piece of iron, thus giving all the appearance of a firm wall.

A Daring Boche Airman

Donald B. Wright likewise of the Nela Lamp Division, enlisted in the 112th Engineers, training at Camps Sheridan and Lee. Overseas, he occupied lines in the following sectors: Baccarat, Verdun, St. Mihiel, Pannes, Ghent and in the offensives of Meuse-Argonne, St. Mihiel, first Ypres-Lys and second Ypres. Donald was discharged April 17th, 1919, ranking as sergeant.

The following story, told by Sergeant Wright, illustrates well the degree to which the Germans carried their cunning practices in the late war.

"The large observation balloons which the allies used along the front were taken to and from the lines on trucks, to which they were fastened down. It was always the practice on these trips to have a number of airplanes hovering near by, so that any air attack which the enemy might attempt upon these balloons could be warded off.

"On one such mission, eleven monstrous bags were being transported to the fighting area near the Argonne. Three American planes were acting as escort, when another American ship, coming out of the clouds, joined the formation. As planes were frequently relieved during such a flight, the approach of this last plane caused no uneasiness among the pilots.

"The four airplanes had maneuvered around for several minutes when the pilot of the fourth ship drew back in the formation, quickly picked up speed and traveling directly over the line of balloons fired tracer bullets into every bag, destroying the entire outfit.

"Having accomplished his purpose he flew in the direction of the German lines, employing every known stunt in his endeavor to get away. The other pilots, however, gradually drove him down from the clouds, and as the pursued pilot made a last loop in his effort to break away, he lost control of his ship and lunged, nose down, to the earth.

"He was none other than a German aviator who had secured possession of an American ship and, realizing the valuable military assistance he would be rendering to the fatherland, had gone forth on this perilous quest. His plane nosed two feet into the earth, and he was crushed to death between the motor controls."

How it feels to be the target of machine-guns mounted on a German Fokker, can be well described by Oscar E. Johnson of the Lamp Equipment Division. Inducted September 19th, 1917, he was assigned to Company L of the 331st Infantry, 83rd Division, at Camp Sherman but was soon transferred to the 19th Engineers. When assigned for overseas duty, Oscar was placed on the roster of the 35th Regiment. In France his duty consisted of aiding in the transportation of guns and material to the front. It was on these missions that Johnson learned to appreciate the velocity of missiles coming from above. At night, especially, did Fritzie take delight in disturbing the peace and on one occasion it was Oscar's painful duty to remove the remains of those who were in the vicinity of an ammunition plant where the German bombers made a direct hit. All of Johnson's tasks were not of this nature, however, for he enjoyed the beauties of southern France for some time, where the sun shines every day and figs, oranges and olives grow in abundance.

To Charles C. Kesler of the Loudon Glass Division, the saddest part of the war took place on board the famous transport George Washington, bound for France. Sailing from Hoboken September 30th, 1918, with nine thousand Yanks, four hundred Red Cross Nurses and a crew of fourteen hundred sailors, the journey took thirteen days and during this time eighty-nine of the passengers died on board ship. When the George Washington reached Brest, France, Kesler's company was detailed to remove and bury the bodies. Kesler was attached to Company B of the 12th Engineers, having enlisted June 25th, 1918, in Columbus, Ohio. Army life was not an innovation with Charles, as he had been attached to the Ohio National Guard for five years before being sent to Camp Humphrey.

Robert N. Duncan, who operated an automatic bulb-machine at the Miniature Bulb Division, was inducted October 3rd, 1917, and ordered to Camp Sherman. He was assigned to Company E of the 308th Engineers. In France, Duncan took part in the action along the Oise-Aisne and Meuse-Argonne fronts. He was discharged July 8th, 1919.

Ralph Mylechraine of the Cleveland Miniature Lamp Division had an unusual part to play, being engaged as a camoufleur with the 40th Engineers. This regiment had the heaviest and largest guns along the front with the exception of those of the Marines. These guns were always moved at night and as the roads were usually in bad condition, due to heavy traffic and incessant rainfall, the task was always a difficult one. As Ralph explained it, in addition to the tractors employed in moving these guns, manpower and "a good deal of strong language" was often necessary. Among the places which Mylechraine visited while overseas were Dijon, Verdun, Nancy and Paris in France, and London and Winchester in England. He experienced the thrills of an air raid at Nancy, in which considerable damage was done to the city.

With a Pick and a Gun

Another overseas veteran, Elmer F. Felske of the Cleveland Wire Division, was called in the draft September 18th, 1917. He was a private in the ranks of Company B of the 15th Engineers, and before going across had seen service at Camps Sherman, Merritt and Upton. In France his duty consisted of building pontoon bridges and laying narrow-gauge railroads. This work was done for the most part under enemy shell fire and at times the engineers were compelled to protect their handiwork from enemy attack until the infantry was in a position to relieve them. Felske was under fire in the Argonne and at St. Mihiel. He was discharged from the army May 26th, 1919.

When H. Leslie Webb left the employ of Nela Lamp Division on May 25th, 1917, to join the Canadian Signal Corps, he was beginning a two-year period of army life which was to carry him through many of the strenuous and critical engagements of the World War. He joined the Canadian Signals at Ottawa, Ontario, Canada, in May, 1917, and was stationed there until November of the same year. Crossing to Seaford, England, he was given additional training until May, 1918, when he proceeded to France. Meanwhile he had been transferred to the Princess Pat Regiment, serving with it four months, and then to the Engineers, with which outfit he served in France. Webb took part in the operations at Amiens, Arras, "Hindenburg Line," Cambrai and Mons. On December 13th, 1918, he crossed the Rhine with the Armies of Occupation, remaining in Bonn, Germany, for seven weeks. He was discharged May 12th, 1919, and returned to Nela Lamp.

Webb relates the following story of a night's activity along a British sector.

"Just before Cambrai was captured in September, 1918, the section to which I was attached was detailed one night to erect a barbed-wire entanglement in front of the support lines.

"We were 'at home' in some captured German trenches in a village called Raillencourt, which lies on the outskirts of Cambrai on the Arras-Cambrai Road. The first day of our stay here my chum and I, with the aid of some timber, corrugated iron and waterproof sheets, had built ourselves a comfortable 'bivvy,' or sleeping place, in an open field. Prior to going on duty we had made our bed with issue blankets and greatcoats, knowing that upon our return in the early hours of the morning, we would be so tired that the spread-out blankets would give us a welcome for a few hours' repose.

"After we had been out several hours under heavy shell fire we accomplished our work, and were wending our way out of the area when a Heinie overhead, to use trench slang, 'let the tail-board of his plane down' and deposited his load of bombs in close proximity to our party. Luckily, no one was hit in our section, although the portion of our company to the right suffered rather heavily. It was with relief that we arrived back at the billet, but when my chum

and I approached our bivvy we were filled with consternation to find the iron roof twisted in pieces, the earth works scattered and our blankets and coats in ribbons.

"While away, the billet had received a direct hit with a shell from a light field gun. Thankful that we had been detailed on night duty, we danced about in wild glee, realizing only too well that had we been asleep there when the shell exploded we would have been twisted even more fantastically than the iron. Thanks to the spirit of comradeship which always prevailed at the Front, other boys loaned us some of their blankets and we were soon asleep, happy in the thought that our day had not yet come.

"I have in my possession a bent coat-button and a small piece of shrapnel, two small reminders of an exciting evening."

Sherman was right! That was the only comment James H. Wilson of the Nela Lamp Division had to make on the war. He enlisted April 6th, 1918, and was attached to the headquarters company of an engineers replacement outfit. During the period of his enlistment Wilson was located in the following camps in the United States: Camp Sherman, Columbus Barracks, Fort Meyer, Washington Barracks and Camp Merritt, and in England at Camp Knotty Ash No. 5, Dideot Camp and Camp Slough. He was discharged July 8th, 1919.

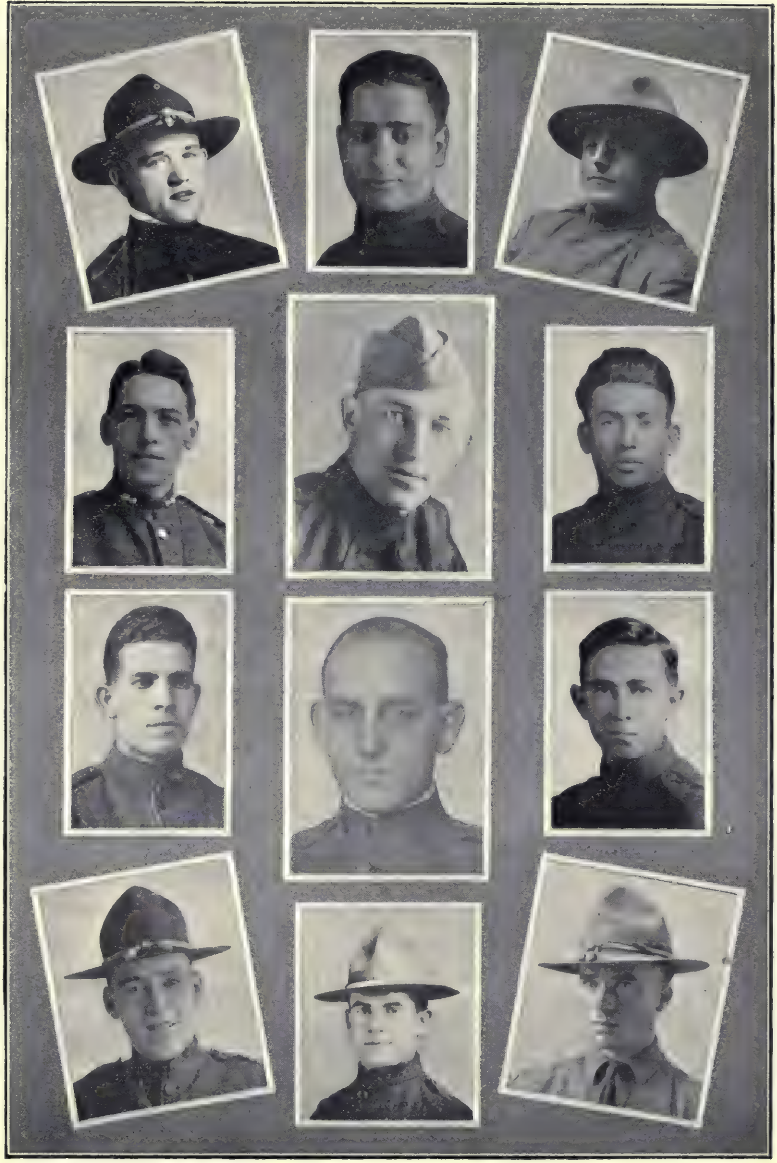
Another engineer going overseas was George L. Bennett. He enlisted May 10th, 1917, in Company B, 5th U. S. Engineers, and trained at Fort Bliss and Camp Scurry, Texas, and Camp Humphrey, Virginia. Going overseas, he was active in the following sectors:

Occupation of Puvenelle sector, west of the Moselle, October 10th to November 9th, 1918.

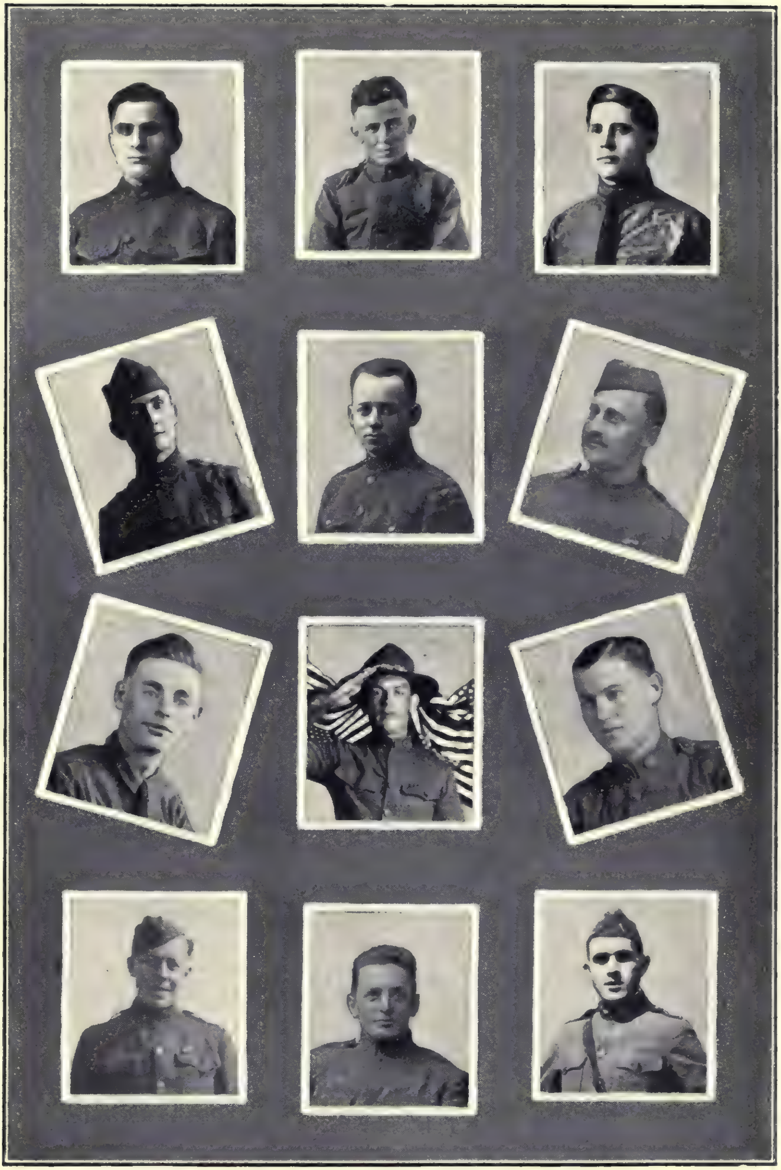
Offensive on Puvenelle sector, November 9th to 11th, 1918.

Upon his discharge from the army, March 29th, 1919, Bennett took a position with the Lamp Equipment Division.

George H. Lindgren enlisted as a private July 27th, 1917, in the 112th Engineers. He was assigned to Company A and ordered to Camp Sheridan. Lindgren was later transferred to Camp Jackson. Upon being discharged from the Army, he was employed by the Lamp Equipment Division. James H. Dunn, a mold shutter with the Rhode Island Glass Division, enlisted May 16th, 1918, and was assigned to Fort Benjamin Harrison, Indiana. He was later stationed at Fort



Lawrence P. Pelton
Joseph V. Hamey
Louis A. Hamel
H. Leslie Webb
Russell A. Paine
William F. Scalley
Carmelo Fotte
Harold E. Pierce
Lewis E. Burdick
Carroll B. Morrison
George F. Trisko
James M. Lenney



Domenico Santangelo
Antonio Persiani
Thomas J. Molloy
James H. Wilson

Joseph C. Tragresser
Earl Howatt
John Exall
Albert Smith

Ernest Voccola
William C. Boehning
Albert E. Bouvier
Fred B. Owen

Douglas, Utah, and Camp Upton, New York. Dunn was mustered out of service December 24th, 1918.

Oscar M. Bulla of the Youngstown Mazda Lamp Division enlisted May 2nd, 1917, in Pittsburgh, as a private with the 15th Engineers, and was encamped at Oakmont, Pennsylvania, June 23rd. He sailed for France, via Liverpool, England, on July 9th, 1917, and was among the contingent of U. S. troops who were the first to arrive in England. His stay in England was very short, being located in the British Camp Borden for a few days before being sent to Le Havre, France. Bulla was in service two years, spending all but about a month or so of this time in foreign service. He was in the St. Mihiel sector for nearly two months previous to the signing of the armistice, and was mustered out of service at Camp Sherman May 15th, 1919.

The 15th Engineers were engaged principally on the construction of narrow-gauge railroads, supply depots, hospitals, etc. Their time during the latter part of the service, however, was devoted entirely to the building and operating of narrow-gauge railroads on the front. The company of which Bulla was a member claims the championship for narrow-gauge railroad building, claiming that they made a record of 3¾ miles, laid and ready to operate, in 7½ hours.

Fred Colcord of the Oakland Mazda Lamp Division enlisted in the 37th Engineers on March 7th, 1918, and trained at Fort Myer, Virginia. On June 30th, 1918, he left for France. He was wounded in the St. Mihiel drive. Colcord also saw action in the Argonne drive from September 29th to November 11th. He was discharged at the Presidio, San Francisco, California, on April 8th, 1919, and returned to work at the Oakland Mazda Lamp Division.

Others in the Engineer Corps were Albert F. Hoh, who was later employed by the St. Louis Mazda Lamp Division, and Arthur J. White, a foreman with the Youngstown Division. Hoh was called September 22nd, 1917, in Ft. Pierce, Florida, and ordered to Camp Jackson. He was assigned to Company E of the 306th Engineers, 81st Division. Later Hoh was transferred to Camp Wheeler, Georgia, where he was attached to Company D of the 106th Regiment of Engineers, 31st Division.

Arthur White was drafted December 18th, 1917, and mustered into the 10th Company, Coast Artillery, at Camp

Nichols. He was transferred to the Enlisted Engineers' Reserve Corps and assigned to Nela Park, Cleveland, where he was employed in the development of vacuum tubes to be used on wireless telephones (see pages 229 to 246). White was released from service April 14th, 1919.

TANK CORPS

The St. Louis Mazda Lamp Division suffered one loss among its eleven service men. This was Edward Franklin Hartman, who was in its employ as a machine adjuster. Hartman was born in Rolla, Missouri, September 13th, 1888. On July 17th, 1918, he enlisted in St. Louis and was ordered to Jefferson Barracks. Here he was assigned to the 326th Battery of the Tank Corps, and later transferred to the Tank Corps Headquarters at Camp Colt, Gettysburg, Pennsylvania. He remained at Camp Colt for a short time and was then ordered to Camp Summerall at Tobyhanna, Pennsylvania. On September 28th, Hartman left New York for overseas, arriving at Liverpool October 8th. Four days later he died from a severe attack of influenza in Belmont Road Military Hospital, and was buried in Everton Cemetery, Liverpool, England. This information was given by Edward's mother, Mrs. Sarah Hartman. In her bereavement of her son his fellow-employees share, proud of the part he played so fearlessly, but grieved for the loss of an amiable comrade and splendid soldier.

The other National manufacturing boy in the Tank Corps was Benjamin Jones, who was employed in the shipping department of Ohio Division. He enlisted April 4th, 1918, in Nova Scotia, Canada, in the Canadian Artillery, but was transferred to the tanks. His training was received at Windsor, Canada, and Bovington, Essex, England.

CAVALRY

Several National men chose the Cavalry, but were not fortunate enough to get overseas. Arnold L. Pipper, later of the Detroit Miniature Lamp Division, enlisted in Troop G of the 14th Cavalry on May 11th, 1917. He spent his service in the following places in Texas: Eagle Pass, Fort Sam Houston, El Paso and Fort Bliss. Pipper was commissioned a second lieutenant after completing a course at the Fourth Officers'

Training Camp at El Paso, and was assigned to the Cavalry as a machine-gun instructor.

Elisha P. Madison, a gas-producer man with the Rhode Island Glass Division, enlisted September 29th, 1917, in the 22nd Cavalry and served at Camps MacArthur, Devens and Fort Oglethorpe, while Joseph C. Tragesser of the Niles Glass Division, after serving at Del Rio, Texas, with Troop K of the 313th Cavalry, was transferred to Battery E, 70th Field Artillery at Camp Knox, Kentucky. He was discharged January 29th, 1919.

Arthur H. Chiconi of the Lamp Equipment Division enlisted May 9th, 1917, in Troop G of the 16th Cavalry. He was located in Brownsville, Texas, until released from service April 25th, 1919. Emil Teschke, also of Lamp Equipment, was attached to Troop C of the 305th Cavalry. His most interesting experiences were those acquired while jumping hurdles and making cross-country rides. This was real sport, and counteracted some of the more unpleasant moments of camp life.

Others in the Cavalry were Sidney C. Smith of the Niles Glass Division and Clifford L. Butler of the Cleveland Wire Division. Smith entered service May 18th, 1918, and was stationed at Russell, Wyoming, and Camp Jackson, South Carolina. Butler enlisted April 5th, 1917, with Troop A, 2nd Ohio Cavalry, and was located for some time at Jefferson Barracks, Missouri. He was discharged December 8th, 1918.

SIGNAL CORPS

This was one of the most important branches of the service, especially in the field, where lay the responsibility of keeping open all channels of communication between the field and headquarters. The work, however, was exceedingly interesting and instructive and the National boys who were fortunate enough to see service in this branch were lucky indeed.

Lawrence P. Pelton of Ohio Division was inducted May 25th, 1918, and after being stationed at Fort Leavenworth for a short time was sent overseas, where he served with the 34th Signal Corps supply squadron.

One other man seeing duty in France was Theodore O. Hagensen, property clerk of the Minnesota Mazda Lamp Division. He was attached to the 11th Depot Battalion at

Fort Leavenworth, which organization was disbanded upon its arrival overseas. Hagensen was placed with the 37th Service Squadron, at Bordeaux, France.

Grand and Glorious America!

Francis T. Fee of the St. Louis Mazda Lamp Division and Arthur F. Evans were also in the Signal Corps. Fee was drafted July 22nd, 1918, and assigned to Company C of the 210th Field Signal Battalion at Camp Funston. Evans, who was later employed by the Illinois Miniature Lamp Division upon his return from service, was attached to the 311th Field Signal Battalion at Camp Grant. Evans occasionally found camp life dull and favorable to homesickness, but when the journey to France was under way, things immediately began to liven up. He was overseas one month before the armistice was signed. Evans sized up England and France as being very wonderful countries, but "not to be compared with our own land." The day that he stepped back on American soil was, as he expressed it, a "grand and glorious" one and February 9th, 1919, was even more wonderful because on that day he was discharged from the army.

Orville A. Harmon was with the 320th Field Signal Battalion. He did not get to France but had the good fortune to see much of this country, being stationed at Camp Lewis, Washington; Camp Fremont, California; Camp Mills, New York, and Camp Lee, Virginia. He was rated as a private, first class, and upon being discharged December 14th, 1918, was employed as a foreman by the Oakland Mazda Lamp Division.

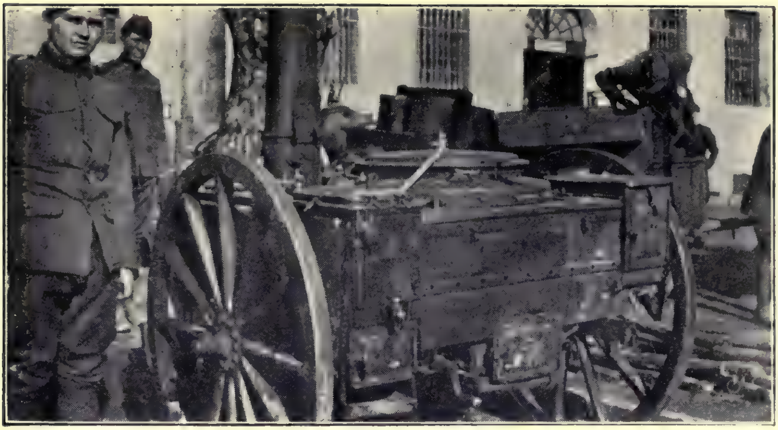
Assistant foreman John J. Stock, of the St. Louis Mazda Lamp Division, was ordered to Washington University, St. Louis, where he received a course in radio. He was assigned to an officers' training school, but before transportation orders arrived the armistice terms had been accepted.

MOTOR TRANSPORT

Realizing the importance of the Motor Transport Service, several men from the National who were employed as auto mechanics enlisted in this branch. Thomas F. Marren entered service April 10th, 1918. After being attached to the Coast Artillery for a few months he was sent overseas and

With the U. S. Army Observers

Gas Mask Drill



Cook Squad at a New York Camp
(Photograph supplied by M. S. E., Hollis Townsend)

A Captured German Field Stove

transferred to a motor transport detachment at Mailly, France, where he had charge of ninety-three men who were to drive trucks up to the different fronts. He was detailed to this work until the armistice was signed, and on December 22nd was returned to the United States with the rank of sergeant. Marren then took a position with the Illinois Miniature Lamp Division.

Two others with overseas records are Glenn E. Norton and Charles Foster, both of Ohio Division. Norton enlisted December 27th, 1917, and trained at Camps Sherman and Mills. For a time he was attached to the office of the Motor Transportation Department in Le Mans, France, ranking as a corporal. Foster entered service May 25th, 1918, and was sent to Camp Jessup, Georgia; thence overseas, where he was attached to the 308th Motor Transport unit. He was discharged July 21st, 1919.

Henry P. O'Rourke, enlisting July 5th, 1917, in Chicago, went across in a convoy of one hundred and two ships and arrived at London in time to witness an air raid and the scene which always accompanied it, people scurrying for safety to the subways, which were bomb-proofed with bags of sand. O'Rourke made four trips across the Atlantic in the Army Transport Service, was attacked twice by submarines and saw three ships sunk. One of these was a Japanese oil tanker which went under in thirty-seven minutes, and one was an English merchant vessel that sank in seven and one-half minutes. Upon returning from France, O'Rourke assumed a position with the Illinois Miniature Lamp Division.

Robert J. J. McDermott of the Providence Base Works and Junius Dana of the Cleveland Carbon Filament Division were also attached to motor transport units. McDermott was stationed at New York University during the two months he was in service, while Dana trained at Camp Holabird, Maryland. He entered the army July 26th, 1918, and was discharged April 14th, 1919. Howard Edwards, later employed by Lamp Equipment Division, was attached to the motor transport unit of the 158th Depot Brigade at Camp Sherman. To Edwards the most fascinating part of the life was "to hear the bugle boy sound first call at five-thirty in the morning."

Francis J. Murphy of the Euclid Glass Division entered service June 15th, 1918, and was assigned to a motor transport unit at Fort Benjamin Harrison, Indiana. His company was then transferred to Camp Jackson. Murphy remained there but a short time, being sent to Camp Taylor where he was assigned to the heavy artillery.

Arthur L. Kremm was inducted from Cleveland on August 15th, 1918. He was assigned to Company 6, unit 306, of the Quartermaster Corps at Camp Holabird, Maryland, but was transferred to the Motor Transport Corps, where he became first sergeant. From Camp Holabird, Kremm was sent to Fort McHenry. He was discharged April 23rd, 1919, and was employed by the Pitney Glass Division, having been with the Euclid Glass Works before his induction.

Stanley G. Cameron of Lamp Equipment Division was drafted May 28th, 1918. He was assigned to the 14th Company, 2nd Replacement Regiment at Camp Gordon, Georgia. Overseas he was located at Dijon, France, serving with the 62nd Transportation Corps as repairman on locomotives and freight cars.

CHEMICAL WARFARE SERVICE

William T. Levitt was both versatile and big—and even he had to admit that he was "some skyscraper" with his towering six feet three and one-half inches of sinew. Twenty-five years old and single, he enlisted December 14th, 1917, in the Chemical Warfare Service and was attached to the Astoria Cantonment at Long Island. But to show Levitt's versatility: after blowing glass in the chemical laboratory for some time, he was made drill sergeant and, being master of more than one art, was made drum major of the detachment band. He was listed for early embarkation when action ceased. Upon being discharged he resumed his occupation as glassblower at Ohio Division.

Edwin J. Hull of the Cleveland Wire Division, who entered service September 13th, 1917, as a first lieutenant in the Sanitary Corps, Medical Department, was transferred to the Gas Defense Division and attained the rank of captain, while Wayne E. Starn, a tube cutter with the Loudon Glass Division, was inducted August 26th, 1918, and assigned to the Light Artillery at Camp Taylor. He was transferred to the Chemical Warfare Service at Edgewood Arsenal, Edgewood, Maryland, where he was located until December 8th, 1918.

Captain Leo G. Cover of the Cleveland Wire Division was commissioned upon entering the Chemical Warfare Service July 1st, 1918. He was stationed in the Development Division Laboratories at Nela Park during the entire period of his enlistment. After the war he became connected with the Nela Experimental Engineering Laboratory, of which Colonel Dorsey was manager.

David F. Koons of the Euclid Glass Division entered service September 5th, 1918, and was assigned to Company K, 4th Battalion, 1st Gas Regiment, of the Chemical Warfare Service at Camp Sherman. He ranked as corporal and was discharged December 16th, 1918.

Three Youngstown Mazda boys in the Chemical Warfare Service were Michael T. Mullarkey, Frank C. Williams, and George E. Norris. Mullarkey was posted at the Edgewood Arsenal Laboratory, Cleveland, then at Edgewood Arsenal, Baltimore, and later at the Development Laboratory, Willoughby, Ohio. He was discharged December 19th, 1918. Williams was employed as shipping clerk until inducted, March 17th, 1918. He was located in the Chemical Warfare Laboratories in Cleveland, working on various experiments connected with the use of poison gas in warfare, until taken ill September 13th, 1918. His case was diagnosed as pulmonary tuberculosis and he was transferred to the United States General Hospital at Fort Bayard, New Mexico, later returning to his home in Niles, Ohio, where he was under the care of government physicians. George Norris enlisted April 24th, 1918, in the Sanitary Corps of the Medical Department and was put on detached service with the Hero Detachment of the Gas Defense Division, Chemical Warfare Service, Long Island City. His duty was connected with the manufacture and testing of gas masks used overseas.

Private Robert H. Smith of the Minnesota Mazda Lamp Division was drafted July 28th, 1918. After serving in the Artillery at Camp Jackson for a short time, he was transferred to the Chemical Warfare Service and stationed at Edgewood Arsenal, Edgewood, Maryland. Lieutenant Edgar C. Bain was commissioned October 8th, 1918, and assigned to the Development Division Laboratories at Nela Park. Upon being discharged February 6th, 1919, he was employed as a chemical engineer by the Cleveland Wire Division.

THE ORDNANCE DEPARTMENT

James C. Lindsay, employment superintendent of the Cleveland Wire Division, chose the Ordnance Department and enlisted August 16th, 1917. He was called to Washington, D. C. and assigned to the Accounting Section. After some time in Washington, Lindsay was detailed at the Remington Arms Company, where he remained until released from service June 15th, 1919.

QUARTERMASTER CORPS

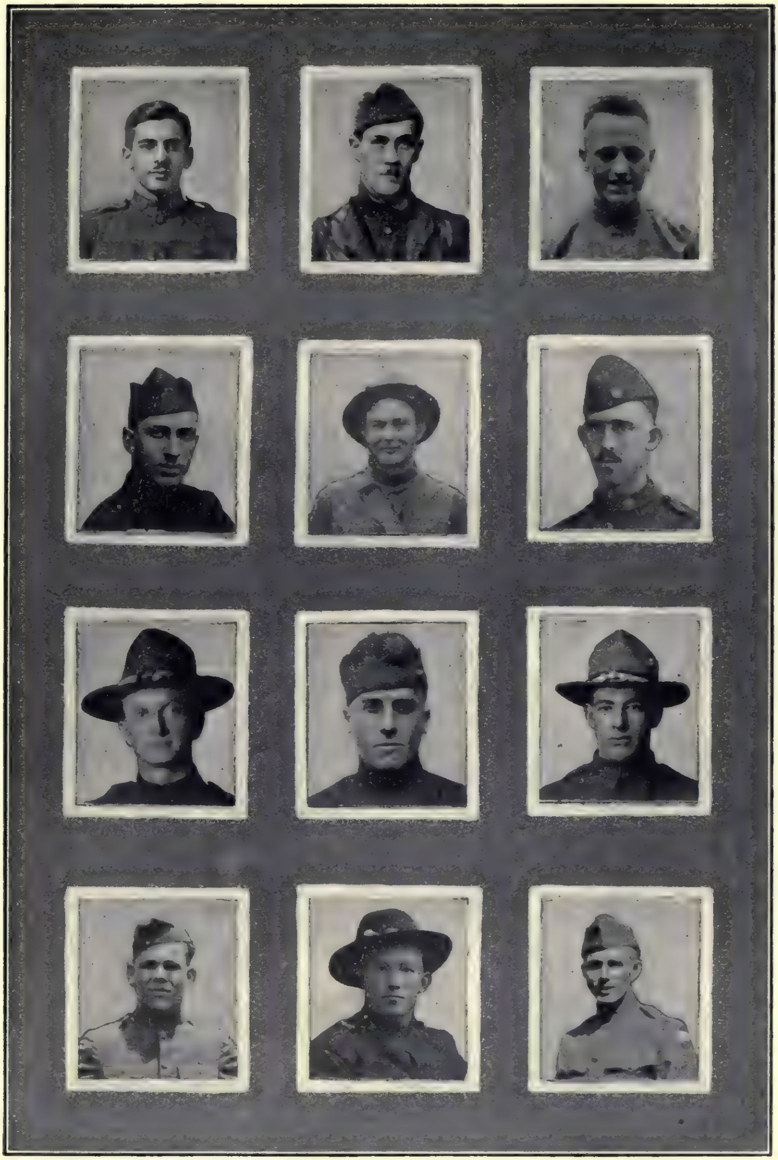
There were four in this service, one of whom went to France. He was Charles F. O'Grady, a foreman at Central Falls. Enlisting December 15th, 1917, he was sent to Fort Slocum and then overseas to Camp Meigs, France. He was discharged June 25th, 1919.

Joseph Raymond Ingram, one of the twenty National men to die while in the service, was born April 14th, 1897, in Dunkirk, Indiana. At the time of his induction, September 6th, 1918, he was employed by the Loudon Glass Division as a drawing-out operator in the tube department. Upon reaching Camp Sherman he was placed in the Quartermaster Corps, and passed examination as a musician with the 28th Company, 7th Training Battalion of the 158th Depot Brigade. He was taken ill soon afterwards and died October 2nd, 1918, of pneumonia.

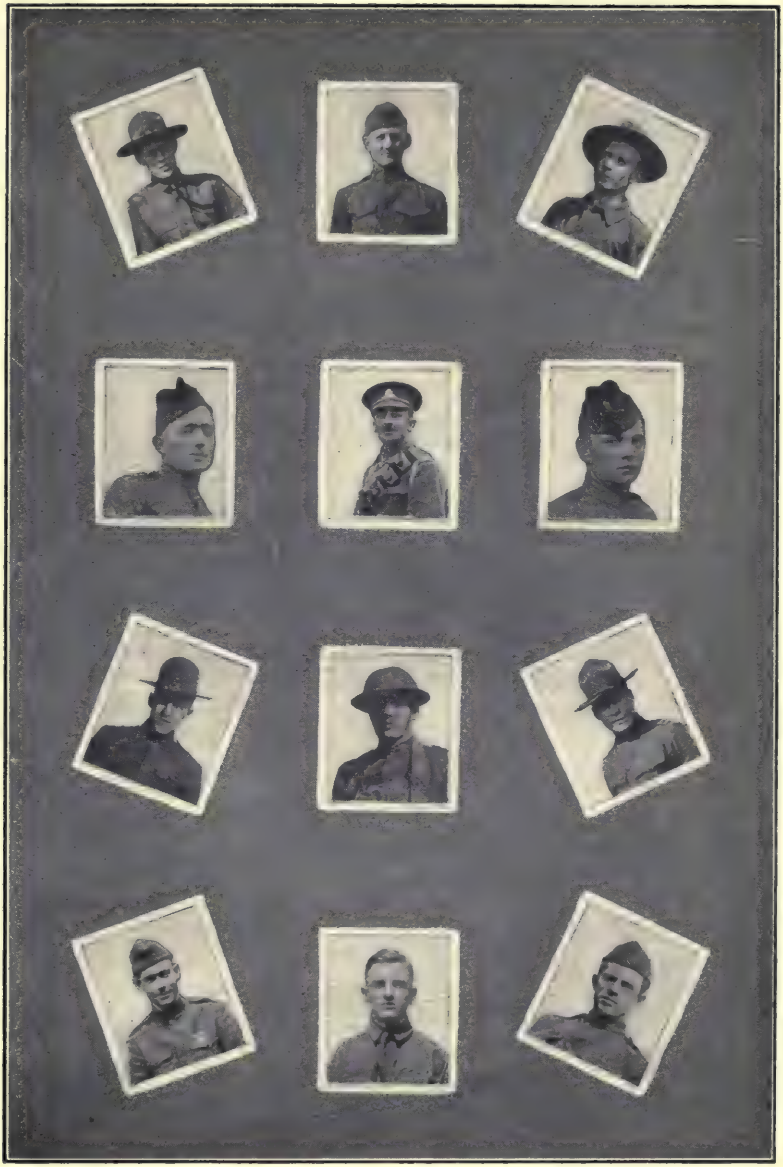
Domenico Santangelo of the Providence Base Works entered service July 23rd, 1918, and was on duty during his army career at Camps Upton and Meigs and at the Edgewood Arsenal, while Albert Smith, shipping clerk with the Rhode Island Glass Division, was at Camp Upton and later at Locust Point, Baltimore, Maryland. He was in uniform from August 29th, 1918 to January 3rd, 1919.

MEDICAL CORPS

Although the cabinets of an army hospital supply room contain practically every medicine listed in the pharmacopoeia, there are about two remedies which are used freely, and these are usually prescribed regardless of the nature of a man's ailment, be it broken bones or sickness. A few men from the National Manufacturing Divisions entered the Medical service and today are probably very efficient



Maurice H. Grossberg Donald B. Wright Michael T. Mullarky
Wallace W. Woods Floyd N. Larremore Otto P. Smith
William Dearborn Raymond Quinn Harry E. Baldauf
Emil Michelson Robert Derosco Walter W. Dieckow



William P. Titus
Ernest J. Griffiths
Holgard V. Jensen
William G. Hilling

Harry A. Thurber
Benjamin Jones
William T. Levitt
Arthur A. Cousineau

Lawrence W. Stark
Walter C. Meyers
Paul A. Holt
William D. Jones

in preparing and "dishing out" these "cure-alls." They are probably adepts, too, in the art of inoculation and vaccination and know just how much iodine to spill on a man's arm before "puncturing."

Lieutenant Paul C. Gauchat, who attended a medical officers' training camp, served in Replacement and Field Hospital Battalions of a Medical Replacement Group and became, to use his expression, a "first-class mule skinner." Upon being discharged from the army he was appointed physician for the Niles Glass Division.

From flash-aging at the Central Falls Mazda Lamp Division to hospital work, was the step taken by Louis A. Hamel. Inducted August 27th, 1918, he was sent to Camp Devens and assigned to the 3rd Company, 1st Battalion, 151st Depot Brigade. He was then transferred to Camp Merritt and finally to a medical detachment at Hospital No. 3 in New York City, where he remained until mustered out of service July 14th, 1919.

Edward L. Doran of the Niles Division was assigned to the Base Hospital at Camp Wheeler, Georgia, March 6th, 1918. He was later on duty at Camp Greenleaf. Forest L. Ritter, a lamp packer with Ohio Division, enlisted December 12th, 1917, in Youngstown, Ohio, and was placed with a medical unit of the Aviation Section. He was first stationed at Fort Oglethorpe and later at Kelly Field, Texas.

John J. Lyons of the Euclid Glass Division was drafted May 28th, 1918, and upon his arrival at Camp Taylor was assigned to the 21st Company, 159th Depot Brigade. He was soon transferred to the Medical Corps at Camp Greenleaf, Georgia, where he was on duty at General Hospital No. 14. Other places at which John was stationed were General Hospital No. 31 at Fort Oglethorpe and at Carlisle, Pennsylvania. He was rated as a private, first class, and was discharged March 17th, 1919.

Earl L. Howatt of the Oakland Mazda Lamp Division was inducted into the service November 15th, 1917, and trained at Camp Lewis, Washington, and Camp Kearny, California. Howatt was a dental assistant in the Medical Corps. He sailed for France July 26th, 1918 and returned to the United States on July 27th, 1919. Receiving his discharge on August 1st, 1919, he returned to the Oakland Mazda

Lamp Division where he resumed his former duties as foreman of the Spider Department.

Bulb blower John M. Walsh of the Niles Glass Division was inducted October 3rd, 1918. He was attached to the Medical Corps and placed on duty at Base Hospital No. 128 at Camp Sevier, Greenville, South Carolina, where he remained until January 1st, 1919.

Charles T. Tenney enlisted April 24th, 1917, and was sent as a member of Ambulance Company No. 9 to the Post Hospital, Schofield Barracks, in the Territory of Hawaii. Upon being discharged December 12th, 1918, he assumed a position with the Oakland Mazda Lamp Division. Theodore G. Chadwick of Ohio Division enlisted June 20th, 1918, and was sent to France as a casual. Part of his time overseas was spent on duty at Evacuation Hospital No. 13 in Luxemburg. He was discharged July 18th, 1919.

AMBULANCE UNITS

Joseph Potter of the Lamp Equipment Division was inducted into service March 6th, 1918, with the 140th Ambulance Company of the 35th Division. He trained at Camp Greenleaf, Georgia, and was overseas from June 8th, 1918 to April 27th, 1919. The work of an ambulance unit in action was anything but pleasant, and the reader can to some extent imagine the experiences which Potter must have had, for he served in the engagements at Wesserling, Gerardmer, St. Mihiel, Meuse-Argonne and Verdun. He returned to the United States early in May and was discharged May 8th, 1919.

S. A. T. C.

The following National men were connected with the Army through the Student Army Training Corps, which was distributed over some five hundred different colleges and universities throughout the country:

1. Arthur A. Cousineau, Central Falls Mazda Division; Rhode Island State College, Kingston, Rhode Island.
2. Arthur C. Gohlke, later with Cleveland Wire Division; Baldwin-Wallace College, Berea, Ohio.
3. Charles Lemr, Nela Lamp Division; Ohio State University, Columbus, Ohio.

4. Grover H. Norman, later with St. Louis Mazda Division; Mississippi A. & M. College.
5. Charles J. Ocasek, later with Illinois Miniature Lamp Division; Chicago University, Chicago, Ill.
6. Harold E. Pierce, Minnesota Mazda Lamp Division; University of Minnesota, Minneapolis, Minn.
7. John V. Rensel, Nela Lamp Division; Ohio State University, Columbus, Ohio.
8. Beryl S. Smith, Lamp Equipment Division; Case School of Applied Science, Cleveland, Ohio.
9. William L. Trimble, Ohio Division; Mount Union College, Alliance, Ohio.

MISCELLANEOUS SERVICE

The following factory men were in the army doing general or limited service, or were detailed to special duty so that it is found convenient to place them in this general classification:

Selden G. Hill of the Puritan Refilled Lamp Division was at Wentworth Institute, Boston, Massachusetts, doing signal work. He enlisted August 31st, 1918, and was discharged December 5th, 1918.

D. G. Campbell, later of the Oakland Mazda Lamp Division, was a second lieutenant of Infantry at Camp Pike. His duty consisted of instructing recruits in bayonet drill.

Michael Nigre, later of the Illinois Miniature Lamp Division, was doing special limited service at Jefferson Barracks, St. Louis, Missouri, being in the service from October 1st, 1918 to December 13th, 1918.

Frank J. Zima, later of Illinois Miniature, was at Camp Wadsworth, South Carolina, but unassigned. He left Chicago for Camp Wadsworth on Armistice Day, November 11, 1918, so that his time in the service was merely a "pleasure jaunt." Zima was discharged nine days later.

Ray J. Von Bank of the Minnesota Mazda Lamp Division was employed as an electrician at the Dunwoody Training Detachment, Minneapolis, Minnesota.

George F. Trisko, also of Minnesota Mazda Division, was with a casual squadron located at Camp Cody, Deming, New Mexico, and later at Camp Dodge, Iowa.

Harry J. Wolfe of the Cleveland Wire Division was with the 14th Company, 4th Training Battalion, at Camp Sherman, but was later transferred to the 1st Gas Regiment at that camp. He was in the service from September 5th, 1918, to December 17th, 1918.

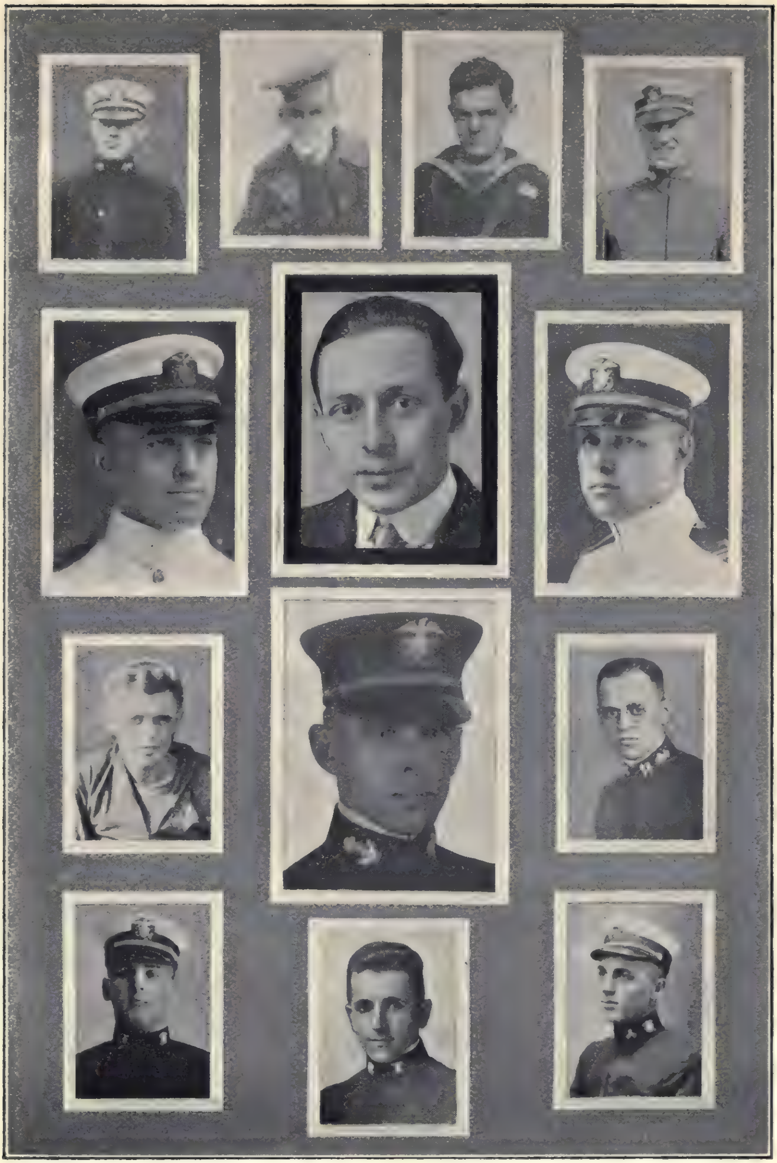
Michael M. Mears, later of the Niles Glass Division, was stationed at Jefferson Barracks, St. Louis, Missouri. He was unassigned.

Raymond Leonard entered the employ of the Rhode Island Glass Division upon returning from service.

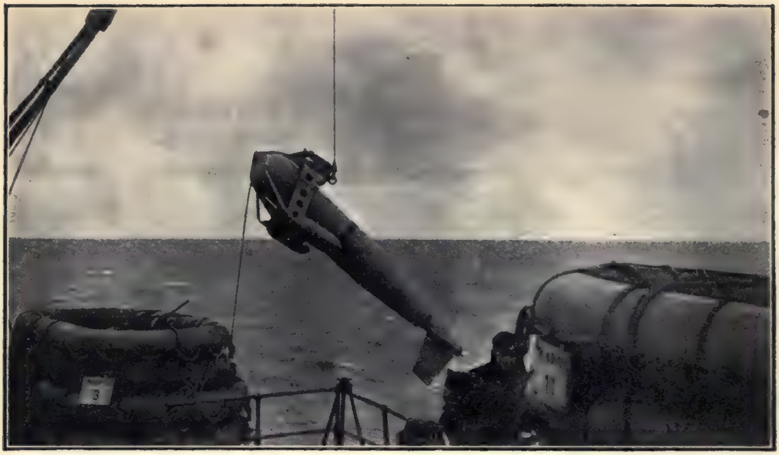
The following records were received too late to be inserted under the proper headings:

Carroll Morrison of the Oakland Lamp Division joined the colors on September 7th, 1917, and was assigned to the 363rd Regiment Band. He remained in this position during the entire period of the war, taking part in the St. Mihiel and Argonne drives. He was re-employed by the Oakland Mazda Lamp Division upon being discharged April 26th, 1919.

Fritz Schuler of the Oakland Mazda Lamp Division reported at Camp Fremont on August 5th, 1918, and was assigned to Company B of the 8th Infantry. Schuler left for France on October 18th, and was promoted to the rank of corporal while enroute. He remained at Brest for nine months, listing troops for return and was then transferred to Germany, to Company A of the 28th Infantry. On September 29th, 1919, he was discharged from duty at the Presidio, San Francisco, California. He returned to the Oakland Mazda Lamp Division.



Harold A. Olson Herman A. Roth Wilbur Porter Howard W. Vanderwerf
Earl A. Anderson Datzel F. Hitchcock Robert W. Davis
James L. Davies Norman P. Sanborn Carl E. Egeler
Ralph A. Nungesser Howard M. Cook Louis J. Rust



A Paravane or Mine Sweeper
(Photograph furnished by Lieut. C. E. Egeler)

A Mine Layer

THE NAVAL FORCES

In order that we may thoroughly appreciate the importance of the big job in which the National's Navy men took part, the following noteworthy facts may be recalled. First, that in a period of nineteen months, 2,079,880 soldiers were transported across the submarine-infested Atlantic, with the loss of but 99 lives, from all causes *en route*. Second, that at the close of the war 5,364,880 gross tons of merchant shipping were in service on the high seas, while during the whole period of the war only 385,967 gross tons were lost. Third, that through the vigilance of the Navy's Coast Patrol our shores and harbors were constantly defended from enemy submarines and aircraft, and lastly, that to the allied navies, our own included, goes the credit for making the German submarine warfare a decisive failure.

No less than eighty-three National Lamp Works men enrolled in the naval service. Of this number, forty-eight furnished us with personal reports of their activities. Forty were in the Naval Reserves and eight were enrolled in the Naval Auxiliary Reserves. When it is remembered that every one of these men volunteered his service, the percentage is pleasingly large and is a distinct indication of the "up-and-doing" type of men who have brought the National Lamp Works its reputation as a progressive organization in the business world.

GENERAL OFFICES AND LABORATORIES

The lure of the waves attracted many men from the General Offices and Laboratories, and judging from the experiences which they encountered and survived, they must have been exceptionally good seamen. Of eighteen reporting, ten went from the Engineering Department. A considerable number of our sailors saw service in European waters.

Naval Reserves

Bruce N. Richardson enrolled March 25th, 1918, as a machinist's mate, second class, and was at Stevens Institute, Hoboken, New Jersey, for some time. In July, he was detailed as an engineering officer aboard the oil tanker U. S. S. "Broad

Arrow," bound for Scotland. Bruce tells the following story of his voyage:

"This was my first experience aboard ship in charge of a regular steaming watch, and naturally I felt rather important and responsible for what was going on in the engine-room.

"We were several days out from New York when something happened which I will never forget. I was on the four to eight watch and had just relieved my man at daybreak. Things were progressing nicely, but there was a heavy fog and we could not see any of the other ships in the convoy. We were going full speed ahead at about nine knots an hour, when suddenly three bells rang out in the engine-room and the indicator moved to full astern. Every one was on his toes in a minute. I closed the throttle, threw over the links and gave her full astern. The machinist's mate ran to the fire room and called for more steam and the oiler was busy keeping the engine cool. It all happened so quickly that no one had time to think of anything else but his assigned work.

"Suddenly the ship gave a jolt and I knew we had either been torpedoed or had struck something. There was nothing for us to do but to stay below and wait for signals. Soon afterwards the bridge telephoned to us that we had rammed an oil tanker. I went up on deck and could see nothing of the other ship because of the dense fog. The water was covered with oil and I knew we had either sunk one of our ships in convoy or damaged her badly. Distress signals blew for hours, but no help came. Our ship was so badly damaged, too, that it had to be taken back to New York, where it was in dry dock for several days."

Richardson was commissioned an ensign. Upon being released from naval duty, February 28th, 1919, he was employed by the Lamp Development Laboratory, Nela Park.

All Hands on Deck! Odd as it may seem, our seamen never confessed to seasickness. Some encountered the heaviest storms imaginable, when the boat was at the mercy of the waves for hours at a time and whales came alongside the boat and were mistaken for submarines. Not that our readers are especially anxious to hear of the misfortunes of others, but because this volume is of an historical nature, we are desirous of recording all the facts; and we fear our friends have at times withheld some from us. Imagine yourself passing through the following experience, as narrated by Ensign Harold A. Olson of the Engineering Department,—yet keeping your digestive processes intact:

"I was in a severe storm which we encountered while cruising off Cape Hatteras. About six o'clock one evening a heavy sea came up, and two hours later the wind was a heavy gale. The seas were so violent that oil was used to abate them, but to no avail. The waves washed over the bridge, and tore several life-boats from the davits. The crew was called out to lash them down, and each man had to have a life-line around him in order to keep from going overboard. The storm lasted several hours, and all this time we were continuously battling the elements. When calm finally ensued, we had several lifeboats to repair."

Olson enlisted as a seaman, second class, and was stationed at the Great Lakes Training Station, on the U. S. S. Columbus, and at the Pelham Bay Training Station. When released, June 13th, 1919, he ranked as an ensign.

Afloat on a Plank in the Atlantic

To Carl E. Egeler of the Engineering Department goes the distinction of being on the ill-fated U. S. armored cruiser San Diego when that ship was sunk off Fire Island. The circumstances of the sinking are familiar history. Bound for New York, out of which port it ran in the convoy escort service, the ship was some fifty miles out of New York City when it either struck a mine or was torpedoed. This occurred about eleven o'clock on the morning of July 19th, 1918, and within thirty minutes the San Diego had listed and turned completely over. Although a crew of approximately twelve hundred was carried, only six lives were lost, three being killed by the force of the explosion. Egeler entered service December 11th, 1917, as a lieutenant, junior grade, and was ordered to the Marine Barracks, Washington, D. C., subsequently serving at the United States Naval Academy, Annapolis, Maryland; on the U. S. S. San Diego; at the Naval Training Camp, Pelham Bay Park, N. Y., and on the U. S. S. Huron. On June 8th, 1918, Egeler qualified for sea duty on combatant ships and on September 21st, 1918 was promoted to lieutenant, senior grade. He was released from service April 17th, 1919.

Norman P. Sanborn of the Engineering Department had at least one decidedly unpleasant experience. Enlisting as a seaman, second class, he was for a time aboard the U. S. S. Dorothea, going from this ship to the Municipal Pier, Chicago, and later to the Pelham Bay Training Station. While on a trip to Glasgow, Scotland, and Queenstown, Ireland, the ship on which Sanborn was assigned lay in a trough of the sea for six hours, unable to go ahead because of a heavy hurricane which made the sea unusually rough. Sanborn stood on the bridge for fourteen hours, with the waves coming over the pilot house.

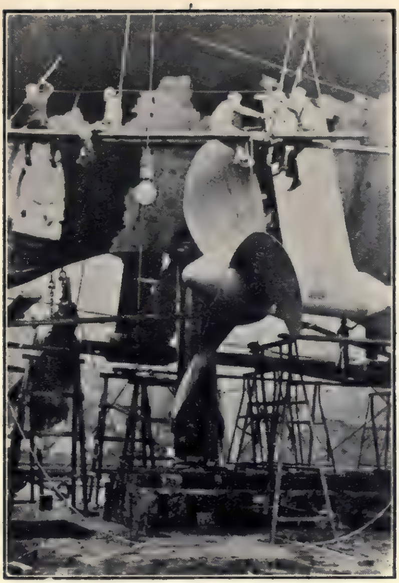
Sanborn was placed on inactive duty April 22nd, 1919.

Lieutenant Earl A. Anderson also went into service from the Engineering Department. He was first assigned to the Bureau of Operations at Washington, D. C., then transferred to the Naval Academy at Annapolis and still later detailed aboard the U. S. S. Oklahoma. He served as senior assistant engineer officer on board the Oklahoma for eleven months, five of which were spent with the naval forces operating in European waters. On June 1st, 1918, Anderson qualified for sea duty on combatant ships and September 21st, 1918, was promoted to lieutenant, senior grade.

Robert W. Davis of the Large Lamp Sales Department enrolled September 7th, 1917, being ranked as chief petty officer. Besides sea duty he was detailed to the following posts: Naval Academy, Annapolis; Boston Navy Yard and Key West, Florida. Davis found his duty aboard the scout cruiser U. S. S. Salem to be the most interesting of his service. This cruiser was assigned to convoy and submarine hunting duty. "Bob" was released May 9th, 1919.

What an Easy Life a Sailor Leads!

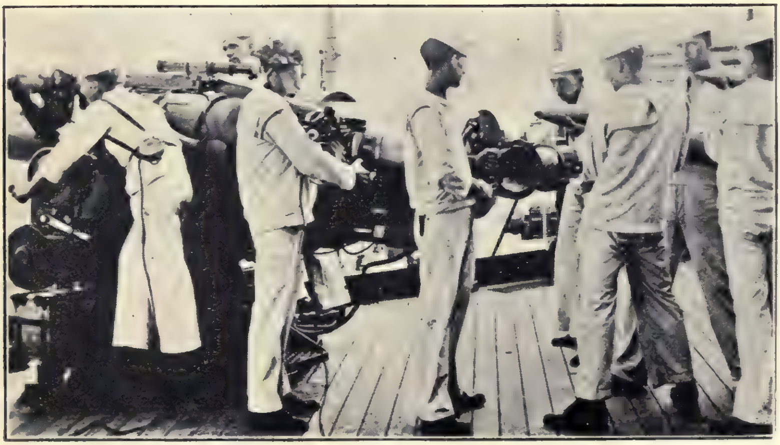
Most of Vinton B. Vernon's time in the Navy was spent aboard submarine chasers. On August 26th, 1918, he volunteered as an apprentice seaman and was sent to the Great Lakes Naval Training Station. Later he was detailed at State Pier, New London, Connecticut. One fine day a fire started on Submarine Chaser 125, down in the powder magazine, with Vernon and seven of his buddies in it. Fortunately,



The Propeller of the
U. S. S. Oklahoma

Scrubbing Hammocks on a U. S. Battleship

(The above photographs were furnished by Lieut. E. A. Anderson.)



Upper Photo—The San Diego. (Photo furnished by Lieut. Egeler, who had a narrow escape when the ship went down.)
Lower Photos—Scenes aboard the U. S. S. Oklahoma. (Middle and lower photographs furnished by Lieut. E. A. Anderson.)

the fire was extinguished, thus giving Vernon the chance to tell about it. He was also on board Submarine Chaser 258 when that boat sprung a leak and the pumps refused to work. The sea was very rough and the 258 barely made port. Upon his release from service Vernon returned to the Engineering Department.

Another Engineering Department naval recruit was DeWitt C. Herrick. Enrolling December 8th, 1917, he was appointed a lieutenant, junior grade, and ordered to the Marine Barracks at Washington, D. C. He was soon transferred to the Naval Academy at Annapolis, Maryland, later serving on board the U. S. S. Louisiana, on board a receiving ship at Philadelphia and in the office of the General Inspector of the Naval Overseas Transportation Service at Baltimore, Maryland. Upon returning to Nela he was employed by the Plant Engineering Department.

James L. Davies of Equipment Development Department was also in the naval forces. He enrolled June 4th, 1917, as a fireman, third class, and served for a time aboard the U. S. S. Iowa and the U. S. transport Montpelier. Davies was released September 26th, 1919, with the rank of chief machinist's mate.

George Savo, who was employed in the New York City office of the Law Department, replied as follows to our request for information:

"On June 4th, 1917, I enlisted in the navy. After a short period of training, I requested foreign service and was placed aboard the U. S. S. Manning, a gunboat, as ordinary seaman. We left Charleston, South Carolina, on August 28th, 1917, for Gibraltar, where an American base had been established and to which base we were subsequently attached. Upon arrival on the other side, I was detailed as signalman and quartermaster.

"For the first few months we acted as danger-zone escort to convoys leaving and arriving at Gibraltar. During this time we encountered two enemy submarines but could get no proof that we had sunk them.

"Beginning with a trip to Plymouth, England, we were detailed as ocean escort to convoys. The ocean escort was the only man-of-war present to protect the convoy during its journey from one danger-zone to the next. Our regular run was from Gibraltar to England, with an occasional trip down the Mediterranean to Oran, Algeria. During one of our trips through the Bay of Biscay we met a German submarine in a fog. It was about 1000 yards ahead. The conning tower was all above water and our gunners managed to get in one hit before the sub submerged. We dropped several depth charges, but the safety of the convoy was at stake, making it necessary to alter our course. It might have been fatal to wait for results. We received word in a sort of semi-official manner that our action in this case had proven successful.

"During the last six months of service I was chief yeoman. I received my honorable discharge on January 26th, 1919, having travelled 60,000 miles at sea, and having been in foreign waters fifteen months."

Fred W. Du Gar of the Engineering Department, who upon being released from the navy was employed by the Pitney Glass Division as an efficiency man, had fourteen months' service in the Naval Reserve. He enrolled March 30, 1918, as a seaman, second class, and was ordered for duty with the Naval Port Guards at Charleston, South Carolina. He was then transferred to the U. S. S. Cypress in the Charleston Navy Yards, subsequently attending the Officers' Training School in Charleston and serving on board the U. S. S. Manito, the U. S. S. Kearsarge and the Submarine Chaser 108. Du Gar tells the following story of one of his experiences aboard the 108:

"On a trip from Santiago to Guantaninco Bay, Cuba, we encountered a heavy wind storm known as an 'intensified trade,' which are quite common in that section of the Caribbean Sea. Our frail craft was submerged during the greater part of the day and we made very little headway. As evening came on, most of us felt as if we were aboard a sub, instead of a sub chaser.

"While plunging through this heavy sea, wondering if ours was to be the fate of a watery grave, a small sail-boat was sighted, the crew of the boat giving every known distress signal. We immediately changed our course and went to their rescue. On arriving at the boat we found it to be a whaleboat from the Hospital Ship U. S. S. Solace. The sailors had started out early that morning on a fishing trip and had been driven out to sea in the heavy gale. We took them in tow and, much to the surprise of everyone, reached Guantaninco Bay safely some hours later, none the worse for our experience."

Walter C. Ibele of the Lamp Development Laboratory enlisted in the Naval Reserves in June, 1918, after having served fourteen months as a civilian employee in the Gas Defense Laboratory at Nela Park on the development of material for gas masks. Upon entering the Navy he went to Minneapolis where he was stationed at the Naval Radio School until the signing of the armistice. Upon his release from service, Ibele again took employment with the Lamp Development Laboratory.

Wilbur N. Porter of the Nela Operating Department enrolled in the Naval Reserve Force, June 18th, 1918, as an apprentice seaman. Before going to sea Porter was stationed at Great Lakes, Illinois, and at the Philadelphia Navy Yard. He made five complete trips across the Atlantic in the convoy service, detailed aboard the U. S. steamships Carola, Wanderer, Auburn and Virginian. Porter was released from the Navy August 21st, 1919.

Others in the Naval Reserve Forces were Ralph Nungesser of Commercial Development; Roy T. Wirth of the Filament Laboratory; George C. Gormly of the Engineering Department and George L. Starkey, later of Equipment Development Department. Nungesser enrolled December 15th, 1917, as quartermaster, third class, and was stationed at the Pelham Bay Naval Training Station and aboard the U. S. S. Mohawk. He was released from active duty February 25th, 1919, with the rank of lieutenant, junior grade. Wirth entered the Navy June 18th, 1918, and was posted at Minneapolis, Minnesota. He was released January 8th, 1919, ranking as a radio operator, second class.

Gormly went into the Naval Reserves October 1st, 1918, and was located with the naval unit at Colgate University, Hamilton, N. Y. He ranked as an apprentice seaman, being released December 18th, 1918. Starkey entered as a seaman, second class, and when released April 23rd, 1919, was an ensign. He was stationed at Municipal Pier, Chicago; Cleveland Training Station; Pelham Bay Park, New York; and at the South Ferry Terminal in New York City.

NAVAL AUXILIARY RESERVES

Howard W. Vanderwerf of the Engineering Department entered service June 25th, 1918, as a machinist's mate, second class. He was first attached to the Pelham Bay Naval Training Station and later to the Naval Steam Engineering School at Stevens Institute, Hoboken, New Jersey. On October 26th, 1918, Vanderwerf was assigned to the U. S. S. Winding Gulf and subsequently had five months' sea duty as a warrant machinist. His ship had several thrilling experiences at sea, such as ramming the U. S. S. Edward Luckenbach, and losing two of the crew who were in a lifeboat which had drifted away. When released May 1st, 1919, "Van" was rated as an ensign.

Yeoman Frederick Beutel, of the Transportation Department, enrolled July 1st, 1918, and was stationed at the Cleveland Naval Training School. He was released February 26th, 1919.

Giving his life for his country was the sacrifice of Datzel Frederick Hitchcock. He was born in Warren, Ohio, June 14th, 1894, and at the time he was inducted was employed by the Engineering Department as a machinist. Hitchcock was assigned to the Merchant Marine and was rated as a marine engineer, third class, on board the U. S. S. Wyandotte. On the fourth day of November, 1918, he sailed for France, arriving there November 18th. The Wyandotte was soon headed west again, and it was on this voyage that Hitchcock met with a fatal accident. It is reported that he was detailed one evening on watch and while making his rounds fell into an open hatchway. He was dead when found, having suffered a broken neck. This lamentable occurrence took place off the Bermuda Islands on the night of December 7th, 1918. His body was brought ashore, and appropriate services were held in the town of his birth.

SALES DIVISIONS

A salesman is popularly thought of as a more or less talkative individual—many of them, in fact, are blessed with the "gift of gab." When discussing our own salesmen, however, this statement must be modified by saying that, when discussing their *own* achievements, they are extremely modest. Here it was to the writer's sorrow, for these salesmen mariners gave him nary a tale, not even an exaggerated fish story which he might spring upon his unsuspecting readers.

Naval Reserves

Albert R. Moredock of the Columbia Lamp Division, entering service April 5th, 1917, as an apprentice seaman, was sent to the Great Lakes Naval Training Station, from there to the Philadelphia Navy Yard and then on board the U. S. S. Michigan. Moredock took great delight in sending a recruit gob to some old service man for a hammock ladder, or if aboard ship would send him around the decks calling and looking for "Charlie Noble," which in reality is the outside compartment of the smoke stacks. Albert was put on inactive duty January 22nd, 1919, ranking at that time as chief storekeeper.

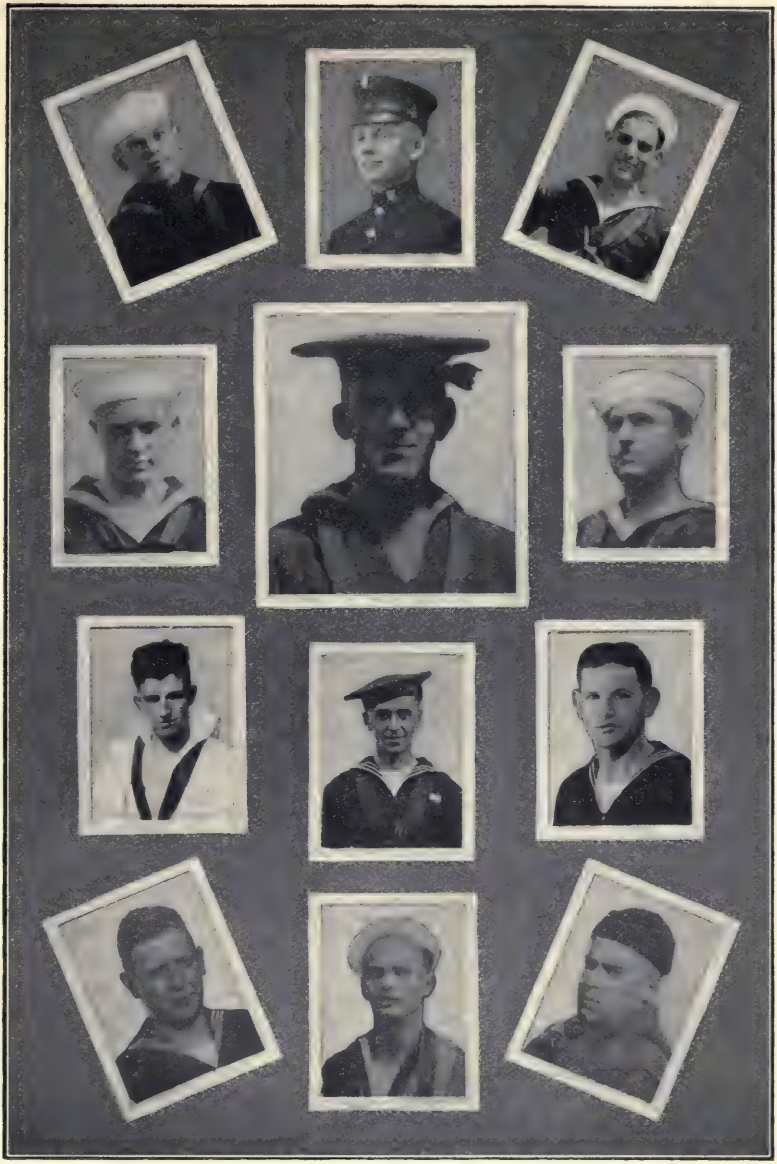
Walter C. Fricke, also of the Columbia Lamp Division, entered the Navy as a seaman, second class, and was located at the Great Lakes Naval Training Station for three months. The rest of his time was served at the Naval Base, Hampton Roads, Virginia. In September, 1918, while at Great Lakes, he was assigned to duty at the Chicago War Exposition doing drill and exhibition work, and during the influenza epidemic was in the camp hospital giving aid to his buddies. He was released February 11th, 1919, ranking as a yeoman.

The Duplex Lighting Works was represented by Frederick Smyth, who enrolled in August, 1917. He was rated as chief storekeeper, but his duties consisted of supervising the loading of supply ships at the Thirty-Fifth Street Pier, Brooklyn; photographing men in connection with the identification system at the headquarters of the Provision and Clothing Depot, Brooklyn, and accounting for the Fleet Supply Base at South Brooklyn.

Walter D. Hunsicker of the Colonial Electric Division enrolled May 24th, 1918, being classified as a seaman, second class. He saw duty at Municipal Pier, Chicago; Great Lakes Training Station and on board the training ship Dorothea at Cleveland. Walter had enlisted in the Army Balloon Corps on December 13th, 1917, but as more men were enlisted in this service than were needed he was given his discharge. Believing the Navy to be the "next best thing," he joined that branch. Hunsicker was relieved from duty December 20th, 1918.

Two other seamen, second class, were William Schmidt, later of the Peerless-Brilliant Lamp Division and Raymond H. Zeller of the Ivanhoe-Regent Works. Schmidt was enrolled May 14th, 1918, and spent all his time at the Great Lakes Naval Training Station doing guard detail and (later) electrical work. Zeller likewise spent his time at Great Lakes; he was released from service January 28th, 1919.

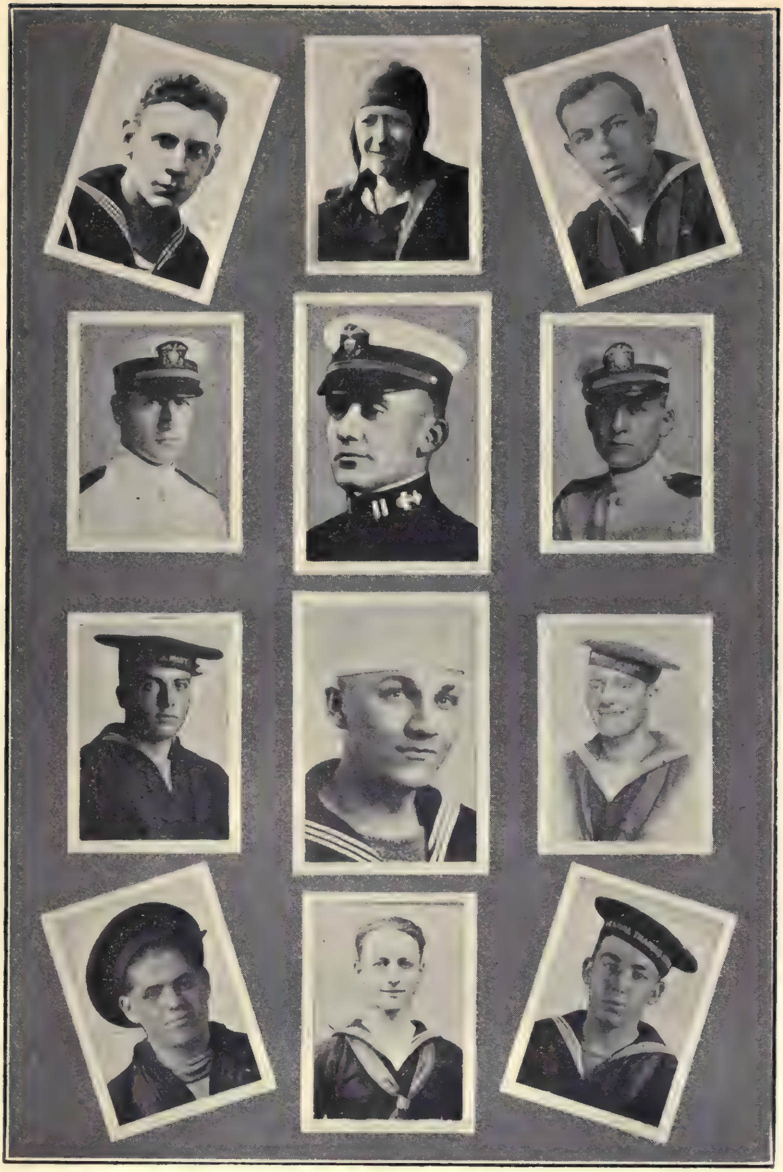
Another in the Naval Reserves was Howard M. Cook, cashier of Nela Specialties Division. He entered service "Friday, the thirteenth" of July, 1917, and reported for duty at the Reserve Training Camp, Newport, Rhode Island. He attained the rank of ensign and was stationed on board the U. S. S. Kerlew, where he was rated as supply officer.



Joseph La Rue
Ormsby D. Miller
Robert J. Fournier
Eugene Wanamaker

Steve Stephan
Edward S. Edwards
Louis Beauregarde
John Williams

Arthur Maganini
Ernest L. Callahan
William J. Kirwin
Arthur P. Roffee



Walter F. Herkner
Lloyd M. Thornton
John Delmonico
John Carter

Leslie W. Parker
William E. Morrison
Harold E. Prince
Lorenzo W. Patterson

Salvatori Mondi
Frederick W. Hild
Harry Firman
George H. Lynch

MANUFACTURING DIVISIONS

Naval Reserves

Walter F. Herkner of the Cleveland Carbon Lamp Division enrolled April 26th, 1918, and was sent to the Great Lakes Naval Training Station as a seaman, second class. He was later transferred to transport duty, and made three trips to Europe on board the United States Transport Harrisburg. This ship had many submarine scares in the Irish Sea and in the Bay of Biscay, but was never torpedoed. Herkner was released January 10th, 1919.

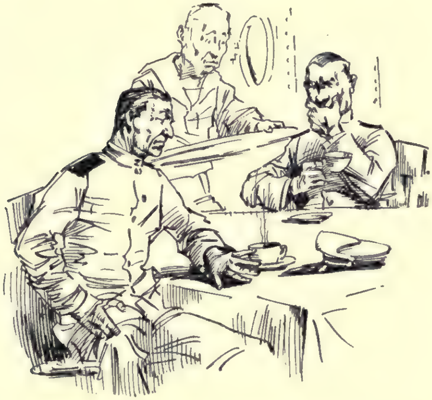
Being commissioned a second lieutenant in the army and then resigning said commission to become a junior lieutenant in the navy, was the unique experience of William E. Morrison of the Cleveland Miniature Lamp Division. He enlisted August 27th, 1917, and was commissioned November 29th, at Fort Benjamin Harrison, Indiana. On December 8th, 1917, he resigned from the army to accept a commission as lieutenant, junior grade, in the Naval Reserves. He was assigned to duty under instruction at Marine Barracks, Washington, D. C., where he remained four weeks. Another month at the Naval Academy and seventeen months aboard the U. S. S. Pocahontas comprised Morrison's naval career. The seventeen months aboard ship were filled with many exciting and anxious moments, for Joe (such is the nickname of our hero), made thirty trips to France in the convoy service.

The Story of the Pocahontas

The history of the U. S. S. Pocahontas is typical of German ships interned in U. S. harbors at the beginning of the war. The Pocahontas was originally the Norddeutcher Lloyd liner "Printzess Irene," and operated between Bremen, New York and the Mediterranean ports. For some time after being interned in New York Harbor she was used as a receiving ship for German officers and men of other interned German vessels. When the United States entered the war the Printzess Irene was taken over for government service. Men who were set to work fitting the ship for convoy duty, found that the German sailors had done all in their power to make the boat unfit for navigation. The walls of both high-pressure cylinders were broken out, both high-pressure valves were destroyed, the main throttle and valves were broken and made way with, the two centrifugal pumps and impellers were put out of commission and the steam cylinders of the main and auxiliary steering engines were broken and the inlet valves thrown overboard. A truly record-breaking job of repair work was performed by Yank engineers and mechanics in redesigning and replacing the broken parts.

On July 25th, 1917, the Printzess Irene was officially accepted by the United States Government and on September 1st, 1917, the name was changed to U. S. S. Pocahontas. The first human cargo carried by this ship arrived in France September 21st, 1917. The name Printzess Irene still decorated the bow of the ship and when it docked at St. Nazaire, loaded to capacity with happy-go-lucky Yanks, the German prisoners at work on the docks were overcome with dumb amazement. They had been told that submarines were sinking all troop transports, and here were Americans adding insult to injury by coming over in German-built ships!

Morrison tells the following true story of the cook aboard the U. S. S. Pocahontas. The wardroom mess had just been started and a seaman, who admitted he knew something about cooking, was installed in the galley. With newspapers for a tablecloth, the officers sat down for their first breakfast aboard ship. Sugar, salt and pepper were on the table in cups, with a spoon in each. Someone remarked that the coffee tasted salty, and the officers naturally concluded that they had put salt in their cups by mistake. A new lot of coffee was obtained, and this time they tasted the sugar before using, but the effect was the same. The cook was called, and on being questioned as to how he made the coffee, replied that the water had been dipped from over the side of the ship!



The Pocahontas had many encounters with submarines, but these appeared to be matters of less worry to the crew than the labors which were necessary to keep the ship's machinery in running trim. Joe states that the "Black Gang" deserves lasting praise for their accomplishments in keeping the auxiliary machinery in condition. He cites in evidence the following verse, composed by the "Black Gang" of the Pocahontas:

"Here's to the man below the decks
In a world of heat and grime,
Where the engine hums and the sun never comes
To mark the passing time;
To the man who holds in his calloused hand
The strength of a mighty fleet,
As he opens the doors where the Fire God roars,
And gives him coal to eat."

Arthur W. Lacasse of the Rhode Island Glass Division entered service December 2nd, 1917, with the rank of apprentice seaman. During his term in the navy he served on the following ships: Massachusetts, Donguan, De Austria, Elcia De Souzon, South Dakota, Mansfield and the submarine G-12. Lacasse had two memorable thrills. One of these was in the Dardanelles. His vessel struck a mine and twenty-four of the crew perished. On the other occasion he was shipwrecked and twenty-four hours elapsed before he was rescued by the U. S. S. Lawrence. Lacasse was released December 5th, 1918, ranking as a fireman, second class.

"It Never Rains But It Pours"

Misfortune dogged the footsteps of Harry Getson of the Ohio Division. After reporting at the Great Lakes Naval Training School he contracted the measles, which, forming on his lung, necessitated an operation in which two ribs were removed. Getson was taken home but suffered a relapse and had to be removed to the Marine Hospital, where another operation was performed. Partially recovering, he again took up work with the navy, this time as a mail truck driver. He had been on duty but a short time when he broke his arm. This was the last news received concerning Getson, but we sincerely hope his afflictions ended with our information.

Arthur P. Roffee, Jr., of the Providence Base Works, reported for duty at the Reserve Barracks, Newport, Rhode Island, and after being located there and at the Brooklyn Navy Yard was dispatched to Submarine Chaser 168 for convoy service. Two months were spent in convoying passenger steamers along the Atlantic coast during the submarine scares, while Roffee made several trips with mine sweepers into mine areas. He was released February 20th, 1919.

Lloyd M. Thornton, likewise of the Providence Base Works, entered the Navy May 12th, 1917. On May 15th, 1918, he received his commission as ensign and reported aboard the U. S. S. Louisiana for duty. From May to November, 1918, he was on convoy service, being transferred November 26th, 1918, to the War College, Newport, Rhode Island.

Lorenzo W. Paterson of the Cleveland Wire Division was at the Great Lakes Training Station from July 13th, 1918 to January 26th, 1919, ranking as a seaman, second class, while Albert B. Carlson of the Providence Base Works enrolled December 10th, 1917, and spent nine months aboard the U. S. S. Tuna. He ranked as a machinist's mate, first class, and was placed on the inactive list January 8th, 1919.

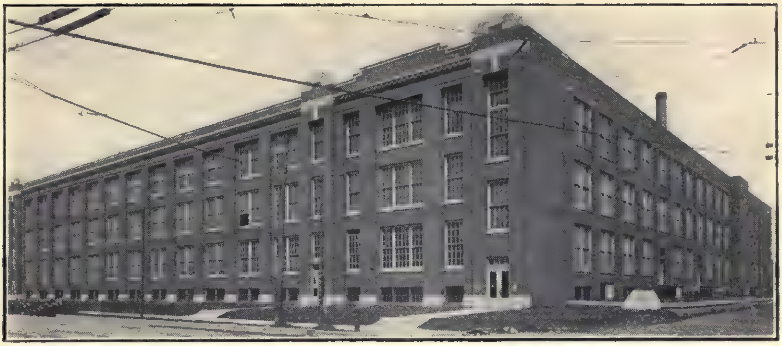
Two Ohio Division boys in the Naval Reserves were Eugene Wanamaker and Shird P. Atchley. Wanamaker enrolled in May, 1917, and after a course of study at Great Lakes and Cambridge, Massachusetts, became a wireless operator. Part of his time was spent on submarine chasers. He was released May 2nd, 1919. Atchley enrolled March 27th, 1918, and belonged to the 5th Regiment, 5th Company, at the Naval station, Newport, Rhode Island. He spent some time in foreign seas in the vicinity of Bordeaux, France.

Ormsby Miller, a foreman with the Illinois Miniature Lamp Division, entered the Naval Reserves December 14th, 1917, as a seaman, second class. The company to which he was attached was detailed to build and maintain the part of Great Lakes Naval Station known as Camp Logan. Before this work was completed, however, Miller was transferred to the New York State Range at Peekskill, N. Y. In May, 1918, he was ordered to Wakefield, Massachusetts, as chief machine-gun instructor, having just completed the course in machine-gun instruction at the Lewis School, Utica, New York. Ormsby later attended the Marine school for machine-gunners at Quantico, Virginia.

Charles Herman of the Miniature Bulb Division entered service June 3rd, 1917, as an apprentice seaman and served aboard the U. S. S. Iowa. He also saw service in the Philadelphia Navy Yard; at Norfolk, Virginia; Baltimore, Mary-

Youngstown Mazda Lamp Division
Youngstown, Ohio

General view of East 45th St. Properties, Cleveland.



DETROIT
MINIATURE LAMP
DIVISION

Upper Photo—Minnesota Mazda Lamp Division, Minneapolis, Minn.
Lower Photo—Detroit Miniature Lamp Division, Detroit, Mich.

land, and New York City, being released December 22nd, 1918.

Two of the National's navy boys died while in the service. One of these was Datzel Frederick Hitchcock, whose record is to be found on page 112. The other was Leslie Willard Parker, who before entering the navy had been employed as a foreman by the Minnesota Mazda Lamp Division. Born August 17th, 1894, in Sauk Rapids, Minnesota, he was a graduate of Shattuck Military School, where he attained the rank of student captain. On April 22nd, 1918, he volunteered and was accepted in the United States Naval Reserve Force. Reporting at the Ensign Training School at Municipal Pier, Chicago, he was made drill master. During the terrible influenza epidemic of 1918, Parker contracted the disease and died November 29th, 1918, at the Marine Hospital, Cleveland.

Ernest L. Callahan, a machinist with the Providence Base Works, was rated as a machinist's mate, first class, and was located at the training station at Newport, Rhode Island. He enrolled July 3rd, 1918, and was released January 27th, 1919. Edward J. Tucker of the Rhode Island Glass Works was aboard the U. S. S. Seneca, serving from July 16th, 1918, to December 31st, 1918, as a seaman.

On May 15th, 1918, Marvin H. Russell, a chemical engineer with the Cleveland Wire Division, entered the engineering section of the United States Navy as a seaman, second class. He reported at the Great Lakes Naval Training Station and was then transferred to the training school at Pelham Bay. From there he was assigned to the Naval Engineering School at Stevens Institute, Hoboken, New Jersey, where upon completion of the course he was commissioned an ensign and detailed to the U. S. S. Mobile as an engineering officer. This ship was in the convoy service and steamed between New York and Brest, France. Russell was released June 15th, 1919.

Apprentice Seaman George H. Lynch of the Puritan Refilled Lamp Division was enrolled at the age of nineteen in the 7th Regiment, 8th Company, at Newport, Rhode Island, and was transferred to the operating base at Hampton Roads, Virginia. He also spent some time aboard the U. S. S. Wisconsin in the Philadelphia Navy Yard.

John J. Burns of the St. Louis Mazda Lamp Division and Herbert G. Miller, later employed by the same Division, were at the Great Lakes Training Station and the Newport Training School, respectively. Burns was a carpenter's mate, third class, and was released March 6th, 1919, while Miller was a seaman, first class, aboard the U. S. S. South Carolina and was relieved from duty January 10th, 1919.

Seaman Charles H. Spink, who was later employed by the Rhode Island Glass Division, enrolled March 22nd, 1918, as a seaman, second class. He spent some time in foreign waters and had one encounter in the North Sea with an enemy submarine which is believed to have been sunk. Spink was released from duty February 8th, 1919.

Two other Rhode Island Glass Division boys in the navy were Joseph R. Fournier and Joseph R. La Rue. Fournier enrolled December 19th, 1917, and was released January 18th, 1919. During this period he saw service on three ships, the Pennsylvania, Housatonic and Patapco. He had nine months' duty in foreign waters, and one skirmish with a submarine, which, according to all indications, was sunk. This occurred off the coast of Scotland; the very same day they were attacked by a German raider but succeeded in getting away. On the morning of June 8th, 1918, the crew of Fournier's ship began to lay mines in Helgoland Bay. In the course of three and one-half hours, 832 mines were laid. The following day the Germans attempted to sweep these mines, and as a result lost three ships.

Joseph R. La Rue, who we believe was the first National man to enlist, entered the navy February 2nd, 1915, as an apprentice seaman and in 1916 was on duty in Mexican waters and at San Domingo. After the United States declared war he was in the convoy service and had two official encounters with submarines. La Rue was released January 31st, 1919, ranking as a coxswain.

Others in the Naval Reserves were William J. Kirwan of the Central Falls Lamp Division; Edward P. Casey of the Niles Glass Division; Jerry J. Ahern, later of the Illinois Miniature Lamp Division, and Philip T. Hawkes, who was later employed by the Oakland Mazda Lamp Division. Kirwan enrolled July 17th, 1918, and was located at the Newport Training Station where he ranked as a carpenter's mate, third class. Casey entered the navy May 6th, 1918, and served at Great Lakes and later at the Dunwoody Training Station. He ranked as an apprentice seaman. Ahern was at

Great Lakes from August 7th, 1918, to December 11th, 1918, ranking as a seaman, second class. Hawkes, an apprentice seaman, was connected with the naval unit at the University of California. He was put on inactive duty December 16th, 1918.

NAVAL AUXILIARY RESERVE

This service attracted three men from the Cleveland Wire Division, Wesley P. Sykes, Harold E. Prince and Harold M. Abrams. Sykes attended the Deck Officer's School at Great Lakes, Illinois, and was later on duty at Municipal Pier, Chicago, and at Pelham Bay Park, New York. He ranked as a seaman, second class. Prince was also a seaman, second class, and after enrolling in the navy June 4th, 1918, was sent to Great Lakes, where he attended Camps Decatur, Perry and Lawrence. Prince was released January 25th, 1919. Abrams entered service September 9th, 1918, as an apprentice seaman. He was assigned to the U. S. Shipping Board Training Ship Missouri at Cleveland until released from service, April 17th, 1919.

Frederick W. Hild of Nela Lamp Division was also in the Naval Auxiliary Reserve, enrolling January 20th, 1918. He rose to the rank of ensign from quartermaster, third class. During the period of his service he was aboard the U. S. S. William B. Dickson; at the auxiliary school, Pelham Bay Park, N. Y.; in the office of the supervisor of the Third Naval District at New York; attached to headquarters of the Naval Overseas Transportation service at Norfolk, Virginia, and aboard the U. S. S. Mexican. Upon his release, February 7th, 1919, he joined the Miniature Lamp Manufacturing Department.

Ivor H. Cadle of Nela Lamp Division was aboard the training ship Missouri and later was assigned to the steamer Richard Trimble. He ranked as an ordinary seaman. Cadle was indefinitely furloughed December 15th, 1918.

THE MARINE CORPS

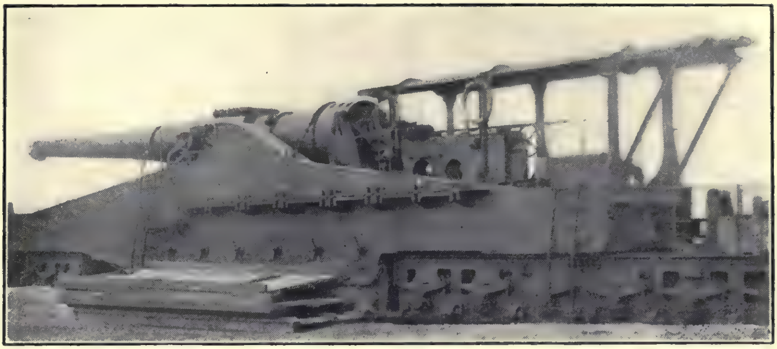
GENERAL OFFICES AND LABORATORIES

The Marines, unofficially known as "leathernecks" or "devil-dogs" (a compliment for which they were indebted to the Germans), enlisted two Nela boys. One of these was George E. Hankison of Credit Department, who enlisted in Cleveland July 24th, 1918. He was attached to Company F of the 11th Regiment at Paris Island, South Carolina, and later was located at Quantico, Virginia. After arriving overseas he saw duty at Tours, Montierchaume and Beaume, France. To George the most interesting events of his service were being pursued by a German submarine, attending a real French military funeral and talking to a French woman who "couldn't compree." While in the Marines, his work consisted of camp and prison guard detail and performing in a post show that toured France. He was later admitted to Beaume University as a government student. George ranked as a private, first class.

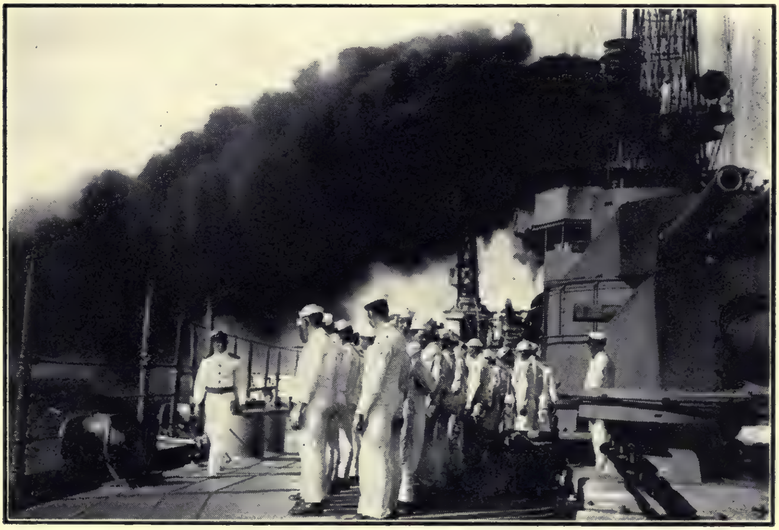
The other Nela "devil-dog" was Ray W. Parshall of the Lamp Development Laboratory. He entered service in Cleveland, June 14th, 1917, and was sent to Paris Island, South Carolina, where he was attached to a supply company of an electrical division. Ray was the recipient of a sharpshooter's medal, having made the highest score with a Springfield rifle. He was discharged March 31st, 1919, being at that date a corporal.

SALES DIVISIONS

The only Sales Division man in the Marines was William H. Pupke of the Fostoria Incandescent Lamp Division. He enlisted in New York City, October 17th, 1918, and was ordered to Paris Island. From there he went to Quantico, Virginia, and later to Hato Mayor and to San Pedro de Macoris, which is located on the Island of Haiti and is part of the Dominican Republic.



"Big Ben"—A Naval 10-inch Gun
(Photograph furnished by Lieut. C. E. Egeler)



Smoke Screen thrown out by a War Ship
(Photograph furnished by Lieut. E. A. Anderson)

Frank Boiles   Clyde R. Lightner   Ray Parshall

Ohio Division, Warren, Ohio

TRUMBULL MAZDA LAMP PLANT

Trumbull Mazda Lamp Division, Warren, Ohio

MANUFACTURING DIVISIONS

Frank H. Boiles of the Youngstown Mazda Lamp Division enlisted as a Marine June 13th, 1917, in Youngstown, Ohio, and went into active service at League Island, Philadelphia, Pennsylvania. He was later transferred to Norfolk, Virginia, and was aboard the U. S. S. Charleston for some time. Boiles was discharged April 30th, 1919.

Private Elmer R. Crossland was first attached to the U. S. S. Huntington at Paris Island. He had enlisted June 6th, 1918, and before being released from service, St. Patrick's Day, 1919, had also been stationed at Brooklyn Barracks, New York, and at the Marine Barracks, Norfolk, Virginia. He was re-engaged by Central Falls Mazda Lamp Division as assistant foreman in the Flange Department.

The third Marine was Clyde P. Freer of Ohio Division. He enlisted in Cleveland, May 22nd, 1918, and upon reaching Paris Island was assigned to Headquarters Company of the 13th Regiment. Freer was later transferred to Quantico, Virginia, and was discharged June 16th, 1919.

Clyde R. Lightner enlisted in the Marines July 19th, 1918, at Mare Island, California. He was later stationed at Quantico, Virginia, and Santa Domingo. Discharged on October 20th, 1919, he returned to work at the Oakland Mazda Lamp Division.

THE AIR FORCES

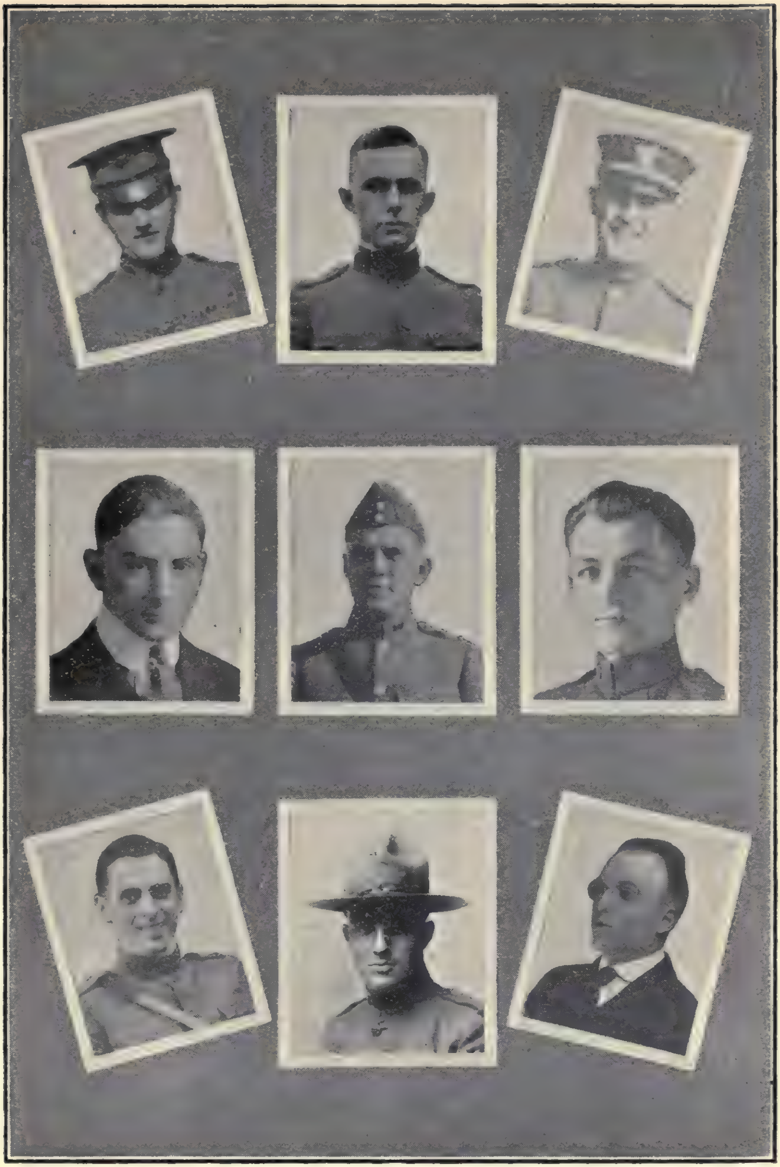
GENERAL OFFICES AND LABORATORIES

In mulling over the questionnaires turned in by the National men of the General Offices and Laboratories who went into the aviation service, the writer unearthed two curious facts. Every man enlisted, and eighty per cent of those entered for actual flying duty were married. The first fact needs no elaboration but the second amuses us. Can it be that married men are so weighted down with cares that they welcome a chance to get up in the air? Of the aviation men engaged primarily in ground or production work, ninety per cent were single. No doubt they had heard the old saying that "marriages are made in heaven," and, preferring the bachelor life, decided that exploring the heavens in a flying machine was a better job for those who were already married.

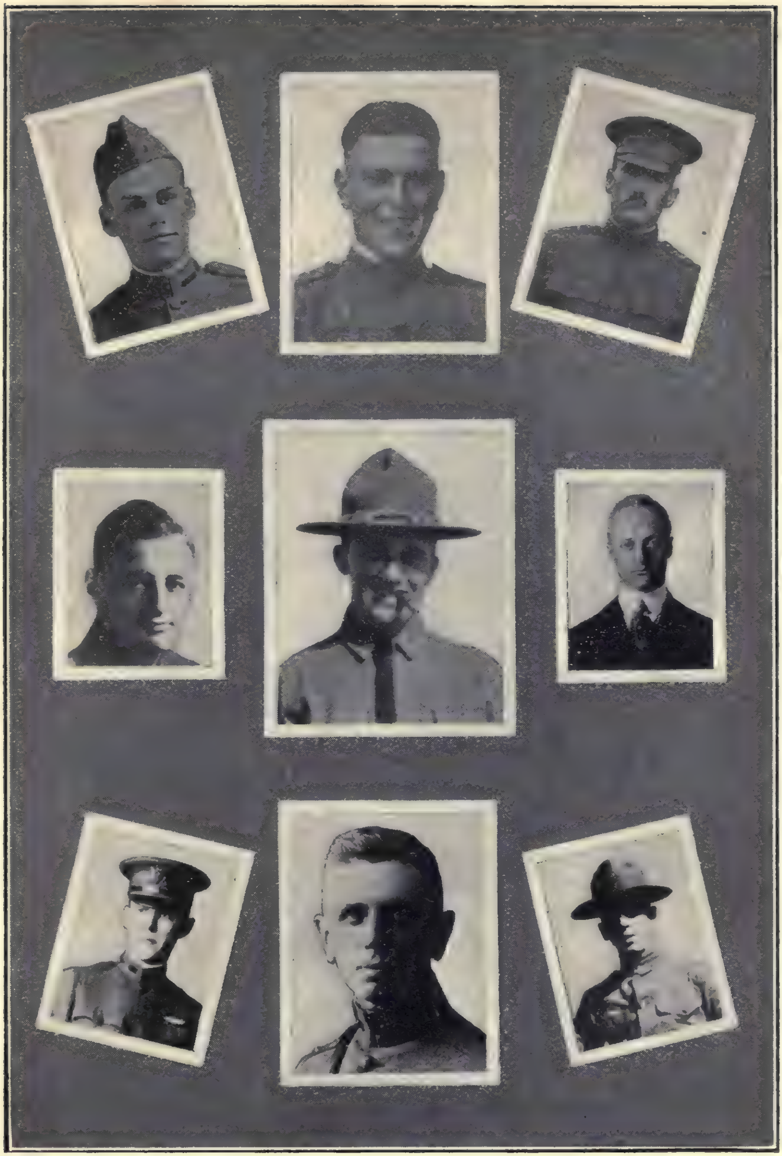
The Engineering Department, not satisfied with contributing the largest number of men to the Navy from the National, likewise gave the greatest number to the Aviation Service. Of twenty men reporting as going into this branch, ten were from the Engineering Department. Nela Operating, Nela Research Laboratory, and Commercial Development each gave two men, while Equipment Development, Statistical, Administration and Large Lamp Sales Departments had one each.

On April 17th, 1917, Lucien D. Coman, Jr., left the employ of Nela Research Laboratory to become a radio operator with the 1st Signal Battalion at Fort Leavenworth. He was transferred to the Aviation Section and sent to Kelly Field, Texas. Among the other places where Coman was stationed were Selfridge Field, Michigan; Mineola, Long Island, and the following points in England: Winchester, Wyton-Huntington, Thetford, South Farnborough and Lord Junction. He remained thirteen months in England, where he was attached to the Royal Air Force as Handley-Page Direction Finder. His work consisted of radio construction and operating. Coman claims the honor of being the second American to direct a Handley-Page plane by wireless. He was rated as a wireless observer, and was on flying status. Coman was discharged December 24th, 1918.

Lieutenant Wayne M. Holmes of the Engineering Department enlisted as a private, first class, with the Aerial Gunnery



Edward A. Buel	Lee C. Kent	Robt. N. Falge
J. Watson Dunbar	Walter Sturrock	Harry Mattis
Clarence J. Berry	Hollis L. Townsend	James M. Ketch



Lorraine G. Hardin — Lucien D. Coman, Jr. — Edward A. Kilroy
George J. Chapman — John J. Turner — Albert E. Wennerstrom
Marion D. Cooper — Arthur Sullivan — William W. Schaefer

branch and was ordered to the School of Military Aeronautics at Ohio State University, Columbus, Ohio. Completing the course there, he was dispatched to the Office of the Chief Signal Officer at Washington. Holmes also saw duty at Ellington Field, Houston, Texas; Rockwell Field, San Diego, California, and in the aviation technical section at Dayton, Ohio. He found aerial gunnery work to be very interesting, especially when operating among the clouds.

Another Engineering Department man commissioned in the air service was Lorraine G. Hardin. Enlisting July 30th, 1917, he was sent to that well known haven of sand storms, Kelly Field, San Antonio, Texas. From there he was ordered to Park Field, Memphis, Tennessee, and then went overseas, where he was on duty at the front from September 1st, 1918, to the date of the signing of the armistice. He was with the 20th Aero Squadron and ranked as engineer officer. He was discharged May 23rd, 1919.

Buel Increases His Knowledge

Ed A. Buel, a sales engineer in the Commercial Development Department, enlisted November 23rd, 1917, and was ordered to Kelly Field, Texas. Among the camps and places where Buel served were Camp Sevier, South Carolina; Rich Field, Waco, Texas; Air Service Depot at Morrison, Virginia; Hazelhurst Field, Mineola, New York; General Supply Depot, Middletown, Pennsylvania, and at the Port of Embarkation, Newport News, Virginia. Ed's task consisted of questioning recruits for card records, and he found that certain nationalities desired particular branches of the service. For example, the Jews favored the quartermaster corps, Greeks and Italians liked the cavalry or artillery, while the Irish leaned toward the infantry. Buel also learned, in conducting intelligence tests, that the college man was by far the most intelligent, while barbers apparently displayed the least amount of "gray matter." The question arises, what about the man who graduates from a barber college? Ed rose to the rank of second lieutenant.

Lieutenant Gillson W. Beals, known to his friends as "Shorty," enlisted December 12th, 1917, and was assigned to the 351st Aero Service squadron. "Shorty" saw service at many camps, among them Kelly Field, Texas; Camp MacArthur, Waco, Texas; Baron Field, Fort Worth, Texas; Air

Service School for Radio Officers, New York (where he earned his commission); Post Field, Fort Sill, Oklahoma, and Gerstner Field, Lake Charles, Louisiana. Beals was rated as a radio officer and was in service one year. He returned to the Commercial Development Department.

Hollis L. Townsend, office manager of the Operating Department, enlisted November 30th, 1917, and was sent to Kelly Field, where he was assigned to the 656th Aero Squadron. Hollis had been in the service but a few weeks when he volunteered for overseas duty and was sent across. Among the places in France where he was stationed were Paris, Romorantin, Libourne and Bordeaux. He was with a service squadron and consequently was kept busy handling the many accessories and spares which were required by the flying squadrons at the front. Townsend experienced several air raids and was in Paris when the Germans' long-range "Big Bertha" first opened fire. He was discharged May 13th, 1919.

A NATIONAL MAN CITED

"*Citation*—Second Lieutenant Walter Sturrock, for exceptionally meritorious and conspicuous services at the Third Aviation Instruction Center, France, American Expeditionary Forces. In Testimony thereof, and as an expression of appreciation of these services, I award him this citation.

(Signed) JOHN J. PERSHING,
Commander-in-Chief."

Such was the honor awarded on April 19th, 1919, to Walter Sturrock of the Engineering Department for the work which he had done during the summer and fall of 1918 at the Third Aviation Instruction Center, Issoudun, France. Walter enlisted November 15th, 1917, and became an instructor in the School of Military Aeronautics at Cornell University. Later he was transferred to a similar school at Cambridge, Massachusetts. From there he was assigned to Call Field, Wichita Falls, Texas, and then went overseas. At Issoudun he was connected with the 31st Aero Squadron, ranking as officer in charge of engineering work at Flying Fields Four, Five and Six. For his splendid work at these fields Sturrock was later promoted to 1st lieutenant.

The aviation men, like the "gobs," were inclined to be reticent and would not accommodate us with any detailed account of their adventures. This is to be regretted, for the writer knows that any man who has been barracked in the hog pens and stables at Camp Dick, or has done much "bunk fatigue" during his service, surely was fed up on more than army food.

In fact, the only surprise we had was to think that our old friend Clarence J. Berry of the Engineering Department would return to France after the war in order to sign his name to letterheads bearing "Brandt & Fouilleret, Material Electrique, 23 a 31 rue Cavendish, Paris, France." Berry enlisted December 13th, 1917, and was sent to radio school. He was commissioned a second lieutenant and sent to France, where he was located at Paris headquarters. Berry made several trips to the front, but the only effect these trips seemed to have on him was to make his love for France stronger. Clarence came back to the States in February, 1919, to be discharged from the army, and returned to France in June of the same year. *Bon voyage*, Berry!

An overseas man was Patrick Vililo of the Nela Operating Department. After service at Fort Thomas, Kentucky, and Camp Sevier, South Carolina, he went to France and served at St. Maixent, Romorantin, Paris and Oxly Field. He returned to Nela early in June, 1919.

He of Engineering Department fame, Marion D. Cooper, enlisted May 4th, 1918, in the flying service and attended ground school at Ohio State University. There Cooper studied motors, learned how to figure deviation and receive ten words a minute on the wireless, besides other information too complex to mention. Completing the course there, he was sent to the concentration camp at Camp Dick, Dallas, Texas, and then to Ellington Field, Houston, Texas, where he was commissioned as a bomber.

George J. Chapman of the Large Lamp Sales Department entered the flying service February 19th, 1918. After ground work at the Massachusetts Institute of Technology and at Camp Dick, he was sent overseas where he was located in Tours, France. Chapman was discharged April 4th, 1919.

Harry Mattis of the Equipment Development Department was one of our overseas boys. He enlisted March 14th, 1918, and was sent to Kelly Field, Texas. Harry went as far as England, where he was located first at Camp Knotty-Ash and later at Codford. During his time in the Air Service he was attached to the 812th Aero Repair Squadron and the 2nd and 322nd Aero Squadrons. He was discharged January 2nd, 1919.

James W. Dunbar of the Engineering Department enlisted in the flying section of the Air Service December 14th, 1917. With two hundred other "barrack aviators" he spent the month of January, 1918, at Fort Wayne, Detroit, Michigan, waiting impatiently for orders which would send him to ground school. These came early in February. The rest of his service was seen at the School of Military Aeronautics, Ithaca, New York; Camp Dick, Dallas, Texas, and Dorr Field, Arcadia, Florida.

"Up in the Air" with a Cadet Pilot

Another Engineering Department man in this service was James M. Ketch who enlisted December 12th, 1917, and attended the aviation school at the University of Illinois. He afterwards attended the radio school at Columbia University, New York City, and was then sent to Fort Sill, Oklahoma. There his task was to instruct in the stripping and assembling of machine guns and in the operation of radio telephones while in the air with some none-too-experienced pilot. It was Ketch's delight to take a joy-ride early in the morning, rising to great heights in order to watch the sun rise through the clouds. It was a three-color symphony of clear blue above, solid silver below and the golden hazy streak coming through the clouds. James was commissioned a second lieutenant, and discharged January 18th, 1919.

The service record of William D. Dorsh, later of Statistical Department, reads Kelly Field, Texas; Camp Morrison, Virginia; Camp Mills, Long Island; Camp Lopcombe, England, and Calais, France. He enlisted December 7th, 1917, and was attached to the 335th Aero Squadron. The happiest day Dorsh spent in the service was in England, when he made

Part of Nela Park—Photo taken from an Airplane

Army Planes used in Photographic Observation Work—
Langley Field, Va.

A Nasty Spill

(Photo furnished by Lieut. W. Sturrock, who witnessed many such accidents "Over There." Lieut. Sturrock is standing with his back to the camera)

A German Anti-Aircraft Gun and its Carriage

(Photo furnished by M. S. E., Hollis Townsend) his first flight in an airplane. These rides became daily occurrences and gave Bill a very decided liking for the air service. He was discharged December 23rd, 1918.

Ralph O. Compton of the Engineering Department became an instructor in ground-school work. He was on duty at the School of Military Aeronautics, Ithaca, New York, and later at the University of Texas, Austin, Texas. He was commissioned a first lieutenant.

Among those commissioned direct from civil life was Dr. Harry M. Johnson, a psychologist with Nela Research Laboratory. He was commissioned a first lieutenant in the Sanitary Corps and assigned to the Air Service at the Medical Research Laboratory, Hazelhurst Field, Mineola, Long Island. During the period of his enlistment Johnson also served at Ellington Field, Houston, Texas, and at the School of Military Aeronautics, University of California, Berkeley, California. At the date of publication of this volume he was Chief of the Section of Psychology at the Medical Research Laboratory, Mitchell Field, and had attained the rank of captain. His work consisted of developing and administering tests for the selection of aviators, and classifying them according to their fitness for particular kinds of aeronautical work. He was also interested in the investigation of the effect of certain aeronautical conditions on performance. Johnson's army life must have been all work and no play, for he asserted he saw "nothing more amusing than aviators."

Lee C. Kent of the Engineering Department, after enlistment, was sent to College Park, Maryland, in the Aviation Section of the Signal Corps. After a month's training there he was sent to Columbia University, New York, to take a 14 weeks' course in the Air Service School for Radio Officers. From here he was transferred to Post Field, Fort Sill, Oklahoma; he was commissioned as second lieutenant at Gerstner Field, Louisiana. He later taught at the Radio School, Carnegie Institute of Technology, Pittsburgh, Pennsylvania. Kent returned to Nela upon being discharged January 17th, 1919.

Albert E. Wennerstrom of the Administration Department reported to the Bureau of Aircraft Production on October 23rd, 1917, as production man. He was made assistant to the Chief of the Ordnance and Instrument Section of the Equipment Division. This section had charge of the production of all the instruments and equipment for airplanes. In September, 1918, Wennerstrom was transferred to the Electrical Section, Oxygen Equipment Branch, and had charge of the production of the high-pressure oxygen cylinders and accessories which are essential to a pilot when flying at high altitudes. He was with this branch of the service until April 30th, 1919.

John J. Turner of Statistical Department rose from sergeant to second lieutenant in the Air Service. He was located at the following places: Columbus Barracks, Kelly Field, Camp Sevier and at the Aviation Fields at Waco, Texas; Morrison, Va., and Garden City, New York.

Joseph Stone enlisted in the Air Service and first trained at Kelly Field, Texas. He was transferred to the Aero Provisional Service at Pittsburgh, Pennsylvania. When discharged from service he was employed by the Lamp Development Laboratory.

NAVAL AVIATION

Nela had but one man in this service—Robert N. Falge of the Engineering Department. Entering service March 5th, 1917, he attended ground school at the Massachusetts Institute of Technology. His flying training was received at the Naval School, Pensacola, Florida. He was commissioned an ensign and placed on inactive duty February 9th, 1919.

MARINE AVIATION

Albert S. Terry, formerly of the Miniature Lamp Sales Department, enlisted in the Marine Flying Corps on July 13th, 1918, and had just completed his ground training at the Massachusetts Institute of Technology when the armistice was signed. Albert ranked as gunnery sergeant, and was discharged December 12th, 1918.

THE AIR FORCES

SALES DIVISIONS

Three men reported from the Sales Divisions as going into the Aviation Service: Ralph H. Garrison of Chicago Bryan-Marsh, Arthur Sullivan of Shelby, and William W. Schaefer of New England Bryan-Marsh.

Garrison enlisted for flying service in November, 1917, and was ordered to the School of Military Aeronautics at Berkeley, California. From there he was sent to Camp Dick where, when not drilling on the race track, he was on fly-swatting detail in the mess hall. Garrison was next heard of at Columbia University, New York City. Other places where he was stationed were Post Field, Fort Sill, Oklahoma; Gerstner Field, Lake Charles, Louisiana, and Camp Doniphan, Oklahoma. He attained the rank of second lieutenant, and was discharged January 6th, 1919.

Attending the Reserve Officers' Training Camp at Fort Benjamin Harrison, Arthur Sullivan was commissioned a first lieutenant, assigned to the Aviation Service and ordered to Kelly Field, Texas. From there he was sent overseas, being stationed in Winchester and later at Doncaster, England. Arthur was discharged December 28th, 1918.

The third man in the Aviation Service was William W. Schaefer who enlisted September 16th, 1918, in the Bureau of Aircraft Production. He was stationed at Fort Slocum, New York, and ranked as a sergeant, first class. His duty consisted of teaching recruits the fundamentals of army discipline. He was discharged February 24th, 1919.

THE AIR FORCES

MANUFACTURING DIVISIONS

The Aviation Service in all its branches was represented by boys from the Manufacturing Divisions of the National. A few were overseas, where they found the life of an aviator to be much more thrilling than it was in training camps at home. The majority, however, were in service squadrons on this side of the water, and their duties were manifold and of great importance. The testing of motors, the assembling of planes, the upkeep of hangars and numerous other details kept the enlisted men on their toes from dawn to dusk. To the airplane mechanic the pilot owes much, for his safety in the air depends largely upon the mechanic's careful daily inspection of his plane.

Thomas O. Moffit enlisted July 2nd, 1917, in the 4th Aero School squadron and on July 9th was assigned to Chanute Field, Rantoul, Illinois. He spent thirteen months at this field, during that time being with the 4th, 16th and 38th Aero Squadrons. As there was no flying done at Chanute Field during the winter of 1917, he was made an instructor in airplane rigging. In the spring of 1918, Tom was put in charge of the hangars and hangar personnel, being in charge of one hundred and five planes and about four hundred men. In May, 1918, he was assigned to the 268th Aero Squadron and sent to Commack Field, Long Island, but after a month's stay there was assigned for overseas duty. The squadron sailed from Boston July 16th, 1918, on the Canadian cattle-boat Wineferedian and had an uneventful journey until, when about two hundred miles off the Irish Coast, it was attacked by four submarines. Luckily, a convoy of destroyers had just met the Wineferedian and the submarines were driven off, one being sunk by means of depth bombs. Moffit landed in Bristol, England, August 1st, 1918, and was sent to a rest camp at Winchester and later to East Borne, where he was stationed for two weeks. At the date of the signing of the armistice Moffit was in Dover, where his squadron was maintaining an American flight for British flyers. He now ranked as chief mechanic and assistant to the engineer officer. On November 21st Moffit sailed for home. He was

Scenes like the above were Common at the Third Aviation Instruction Center, France, (Largest Flying Center in the World)
(Photograph furnished by Lieut. W. Sturrock)

An Aeroplane View of German Line at Meuse-Argonne—Sept. 26, 1918
(Illustration furnished by Lieut. Wilber Johnson)

Edward R. Shimonek Earle L. Windenberg William D. Brown
Herbert E. Quinlan
Walter L. Peters Charles T. Nottage Clarence W. Thornbur

Lamp Equipment Division, E. 152nd St., Cleveland discharged January 24th, 1919, at Camp Grant. Upon returning to civilian attire, he assumed a position as mechanic with the Illinois Miniature Lamp Division.

The Guntner brothers, Frank G. and Jay A., both in the employ of the Lamp Equipment Division, enlisted March 16th, 1918, in the Air Service. They were ordered to Kelly Field, Texas. Jay was attached to the 310th Aero Squadron and later to the 608th, with which organization he went overseas. He had gone as far as Winchester, England, when the armistice was signed. Jay was discharged January 27th, 1919.

Frank, after parting from his brother at Kelly Field, was sent to Gerstner Field, Lake Charles, Louisiana, where he was attached to a service squadron. He was discharged January 13th, 1919, ranking as a private, first class.

Leon T. Fahrenthold, who entered service January 16th, 1918, as a cadet pilot, was assigned to the School of Military Aeronautics at Austin, Texas, but was transferred to the Chemical Warfare Service and located at the Defense Laboratories at Nela Park. Upon being discharged December 30th, 1918, he took employment with the Cleveland Wire Division.

Corporal William D. Brown, of Ohio Division, enlisted in Youngstown December 12th, 1917, and was sent to Fort Omaha, Nebraska. Later he was transferred to Camp Morrison, Virginia. In France Brown was attached to the 102nd Balloon Company. He was discharged May 21st, 1919.

A Lafayette Escadrille Representative

Only one National man was in the ranks of the American Lafayette Escadrille. He was Private Charles T. Nottage of the Lamp Equipment Division. Nottage enlisted July 30th, 1917, in Cleveland, and after arriving overseas operated with a French Army division in the Champagne, Chemin des Dames and Flanders sectors from February 18th, 1918 to June 30th, 1918, and with the American troops in the Toul sector and in the St. Mihiel and Meuse-Argonne offensives from July 4th to November 11th, 1918. The Escadrille was permitted to wear the fauragere, which is part of the French uniform and shows the number of citations a company has. Nottage was discharged April 18th, 1919, and ranked as a private, first class.

Lieutenant Walter Le Roy Peters of the Illinois Miniature Lamp Division entered service December 1st, 1917, and attended the School of Military Aeronautics at the University of Illinois. Graduating, he was sent to the concentration camp at Camp Dick, Dallas, Texas, which Peters says was "a very nice place, providing you were not in the army." At Camp Dick, the time of the "flying infantry" was taken up with drill, calisthenics, boxing, bayonet and gas-mask drill, sweeping the Fair Ground streets, kitchen police and fly-swatting detail. Finally one of the innumerable rumors concerning transfer to flying field came true, and Peters was sent to Scott Field, Belleville, Illinois. After three months of dual and solo work, he was commissioned. Discussing the planes, Peters said that "Curtiss made the ships, but that God flew a great many of them."

After receiving his commission, Peters was made an instructor, and the task of teaching cadets he found to be very amusing but often dangerous. He was soon transferred to Kelly Field, a place which everyone tried to avoid, but a few days at that field convinced him that flyers really learned the game there. Altogether, Walter had about two hundred and seventy-five hours in the air. He was rated as a pursuit pilot instructor.

On August 2nd, 1917, Edward R. Shimonek heeded his country's call and enlisted in the 316th Field Signal Battalion. He was sent to Camp Lewis and was later transferred to the 411th Aero Construction Squadron at Vancouver Barracks, Washington. His work consisted of drill instruction, and of rounding up alien enemies and I. W. W.'s in the lumber and spruce camps of the Northwest. Ed was promoted from private to sergeant and then to second lieutenant. Upon being discharged from the army January 11th, 1919, he returned to the Oakland Mazda Lamp Division as foreman.

Mechanic John W. Harwood of the Lamp Equipment Division enlisted in Cleveland, March 16th, 1918, and was sent to Kelly Field, San Antonio, Texas. Harwood did not tell us any of his army experiences, but probably considered that Texas sand storms needed no explanation. He was discharged January 4th, 1919.

A Niles Glass Division lad, Clarence W. Thornburg enlisted in Youngstown, Ohio, August 14th, 1917, and was ordered to Kelly Field. He was attached to the 97th Aero Squadron and on October 27th, 1917, sailed for France, where he remained until February 12th, 1919. Thornburg was stationed at

Clermont Ferrand, France, and was connected with a bombing squadron. He experienced many air raids, but managed to escape harm.

Steve Janidlo of the Lamp Equipment Division was inducted August 3rd, 1918, in Cleveland, and sent to Camp Sherman, where he was attached to the 158th Depot Brigade. He was soon transferred to the Air Service and ordered to the aviation depot at Fort Wayne, Detroit, Michigan, where he remained until discharged, January 23rd, 1919. During the epidemic of influenza, Steve was confined to the hospital for five weeks but, thanks to the good care given him, his condition never became critical.

Another Broken Heart

Mechanic Albert L. Swenson enlisted June 25th, 1918, in Minneapolis, and was sent to the Mechanics School at St. Paul, where he was attached to Company D of the 872nd Aero Squadron. On October 1st, 1918, he was ready to join an overseas squadron, when notified that he had been appointed an instructor in aerial motors. On November 11th the Germans dealt him a severe blow by signing that little document known as the Armistice, for just two days previously he had been accepted as a candidate for a commission in the flying section of the Air Service. Swenson was discharged December 21st, 1918, and took employment with the Minnesota Mazda Lamp Division.

Carl Meyers, who was later employed by the Euclid Glass Division, enlisted in Cleveland and was placed on duty at Sutton, West Virginia. Later he was transferred to the Pittsburg Arsenal, from which he was discharged February 28th, 1919.

Lieutenant Robert L. Colthart, who was attending school at the time of his enlistment in the infantry, June 11th, 1917, was sent to Fort McDowell, Angel Island, and later transferred to the Air Service. Afterwards, he was on duty at Kelly

Field, Texas; Camp Gordon, Texas; Fort Omaha, Nebraska; Vancouver Barracks, Washington, and Presidio, California. Upon being discharged from the army January 11th, 1919, he took employment with the Oakland Mazda Lamp Division.

Enlisting December 13th, 1917, Bertrand A. Cramer was ordered to Kelly Field and attached to the 307th Aero Squadron. From there he was sent to Waco, Texas, and later to Camp Greene, Charlotte, North Carolina. On July 31st, 1918, Cramer sailed for overseas and was stationed in England until December 10th, 1918, being at Winchester, Rendcomb and Camp Knotty-Ash. After arriving in England he was accepted as a candidate for a commission in the flying service, but the armistice cut short his flying aspirations. He was discharged December 29th, 1918, and employed by the Euclid Glass Division.

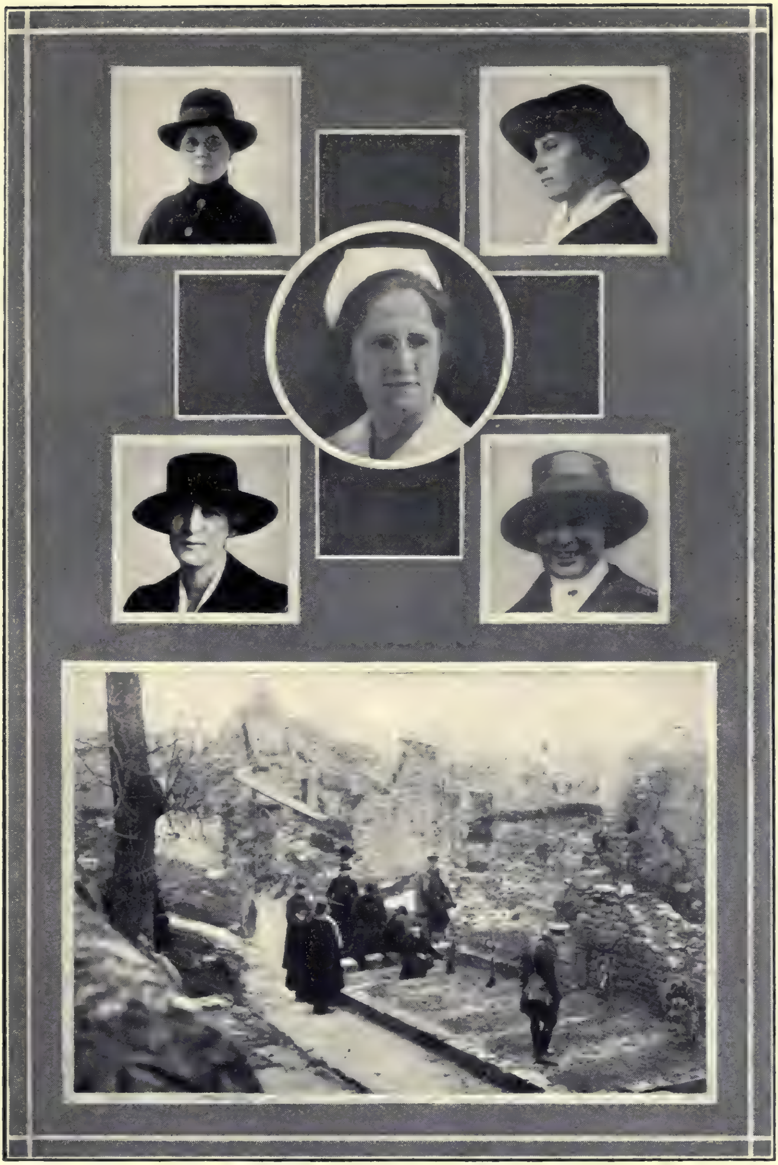
Charles Frett enlisted December 4th, 1917, at Belleville, Illinois, and was ordered to Scott Field, where he was with the 221st Aero Squadron. He was afterwards placed on detached service at Dayton, Ohio, and at the time of his release from the army, January 3rd, 1919, was at St. Paul, Minnesota. He took a position in the Sealing Department of the St. Louis Mazda Lamp Division.

Entering service September 16th, 1917, Joseph A. Vise of the Euclid Glass Division was assigned to the 331st Infantry of the 83rd Division. He was soon transferred to the 680th Aero Squadron and ordered to Kelly Field. Other camps at which Vise was stationed were Camp Greene, North Carolina; Mitchell Field, Mineola, and Garden City, New York.

Roy L. Leighton of Lamp Equipment was in service two years. Part of this time was spent in Coblenz, Germany, with the Army of Occupation.

MARINE AVIATION

Chester M. Sullivan of the Minnesota Mazda Lamp Division entered the Marine Aviation Corps July 3rd, 1918, as gunnery sergeant and was ordered to report at the Massachusetts Institute of Technology, Boston. After completing the course at this school he was sent to the Marine Flying Field, Miami, Florida, where he was stationed until released from service, December 19th, 1918. Sullivan's most thrilling experience in the service was his first tail spin. He does not describe the feeling, leaving that pleasure to the reader's imagination.



Miss Laura E. Moore Miss Frances Ashford

Miss Beatrice A. Fahey

Miss Emily E. Colquhoun Miss Anne Carlton

Lower Photo: Nurses Decorating Graves in France

How the Yanks received the News of the Armistice

NAVAL AVIATION

The only National manufacturing man entering this service was Herbert E. Quinlan of the Nela Lamp Division. He enlisted July 25th, 1918, and ranked as chief quartermaster, being stationed at the United States Naval Aviation Depot, Seattle, Washington. He was later transferred to the naval air base at San Diego, California, where he remained until released from service, December 20th, 1918.

OUR ARMY AND RED CROSS NURSES

Doing service in the Great War implied above all the obligation of giving oneself, heart and soul, to a cause. To the soldier it brought the test of giving up home, comfort, friends and all the surroundings of his daily life and endangering himself to enemy fire, but with the knowledge that he was as well prepared and as well armed as the foe who faced him. To the civilian it was the sacrifice of time and money and the curtailment of routine pleasures to which he was accustomed, but with the element of personal danger erased.

To the nurse the sacrifice was a combination of both. Her home life was dissolved and as she sailed away, behind her were left friends, comfort and the ample necessities of life, while before her was intimate danger, for unlike her ward, the soldier, she was not armed, nor was she prepared by months of preliminary physical training to endure the hardships that were to follow.

It was the National's privilege to place on its Honor Roll the names of five women who volunteered their services to the American Red Cross or Army Nurses Corps,—Miss Moore, Miss Colquhoun, Miss Fahy, Miss Ashford and Miss Carlton. These Yankee women served in France and were located in American and British hospitals where they were kept busy from dawn to dusk. Their task was of a dual nature, for not only did they minister to the physical ailments of the sick and wounded, but they had to see that the morale of the patients was kept up,—and in this they were very successful. All reports emphasize the sterling qualities displayed by these nurses, and the rank and file of American citizenship takes off its hat to the accomplishments of the bearers of mercy. The civilian praises them for their valor;

the soldier honors them for the gentle and invaluable aid which they rendered to the sick and wounded.

War Workers In White Miss Laura E. Moore, at the time she volunteered her services, was in charge of the Service Department at the East 152nd Street plant, Cleveland. She enlisted September 12th, 1918, in Cleveland, in the American Red Cross. Overseas she was on duty at Military Hospital No. 5 at Autcuil, France. Her story is told here in her own words:

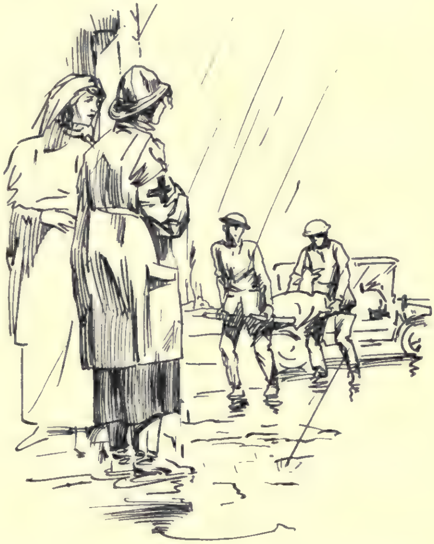
"I found my entire service very interesting but, as I look back over it all now, it seems to me that I was needed most and able to render the most service while crossing the ocean, when they were dying faster than we could care for them. Our second day out, they commenced being taken down with a severe form of influenza and pneumonia. We nurses were pressed into immediate duty, and worked from twelve to fifteen hours a day our whole trip. We buried one hundred and sixty-five at sea during our voyage, and when we reached Liverpool many more were taken to hospitals and left. When I reached France, I was fortunate in being placed in the largest tent hospital in the world, where I remained during my entire overseas service. We accommodated twenty-five hundred men at one time, and our experiences there were wonderful."

Her record speaks for itself, and nothing need be added to illustrate her sincerity and devotion unless it be an extract from a letter which she wrote to her friends at E. 152nd St. as an appreciation for the kindness shown her before she sailed for France. She wrote in part:

"I would like to shake the hand of each and every one of you and thank you from the bottom of my heart for your kindness and thoughtfulness at this time, and even this would not express the sincere appreciation I have in my heart for this very wonderful help. So when I am 'over there,' rendering in my small way what help I can to those who have given their all, I shall think of you, my friends, back here in Cleveland, who have helped to make it easier for me to do what I am able to do."

Miss Moore was released from service February 12th, 1919, and her return to East 152nd St. was a happy event for all concerned.

Another nurse who saw considerable service was Miss Beatrice A. Fahy, Service Secretary at the Minnesota Mazda Lamp Division. Miss Fahy enlisted in the Army Nurse Corps in Minneapolis on April 11th, 1918, and was sent to Fort Des Moines, Iowa. She was soon ordered to France, where she was stationed for a time with Base Hospital No. 66 at Neufchateau, and later with Camp Hospital No. 12 at Valdahon. In referring to her service, Miss Fahy said:



"Aside from fighting the battle of spinal meningitis with the 'Wild Cat' Division (the 26th Division) in Camp Hospital No. 12 at Valdahon, France, living on cold boiled potatoes, 'corn willie,' hard tack, 'gold fish' and baked beans for three months, and being attired in raincoats, rubber boots and rain hats throughout our stay in 'Sunny' France, our work was like the work of any of the nurses who left God's country to do our mite."

Miss Fahy was discharged June 1st, 1919, ranking as head nurse.

The third army nurse was Miss Frances Marie Ashford, who was employed by the St. Louis Mazda Lamp Division as Assistant Service Secretary and Emergency Nurse. She enlisted August 18th, 1917, and was assigned to a detachment of the St. Louis Medical Unit No. 21. She sailed for France in October, 1917, where she joined the original unit. Miss Ashford narrated that "there were many amusing incidents as well as many sad and terrible experiences. We worked from early morning until late at night. One hospital consisted of tents and boarded-up huts, with no conveniences, but I enjoyed the work and was loath to return, even on account of illness."

Miss Ashford was in service as late as January 1st, 1920.

Miss Emily E. M. Colquhoun, who previous to enlisting in the Lakeside Unit of the Army Nurse Corps, August 14th, 1917, was a Service Secretary at the 45th Street Properties, was attached to the British Expeditionary Forces at Rouen, France. Her time was spent at Base Hospital No. 4 and Mobile Hospital No. 5. From a letter which she wrote under date of January 28th, 1918, we get some idea of the service she rendered. She says, in part:

"It is so strange to be cut off from people; we can hardly realize it as we go along being just ourselves and living our lives from day to day and meeting all the new sensations and thrills. It is so strange to have vanished from all you people into the gray cloud which veils France from the rest of the world.

"I wish you people could share all this life of ours with us. It is full of the charm of feeling that one really counts in the work the world has to do. It is full of sad things, but it is also full of the most delightful bits of humor and fun, and in our wards there is lots of laughter and the boys have many happy hours.

"Last week we had in our ward a man who had been in one of the big opera companies, and next to him was a man who had played first violin in the Grenadier Guards Band. We hunted around until we found a violin, and for several days we worked to the most beautiful music. Our singer sang and our violinist played and we had bits of opera and bits of Tommy songs and those who were not too sick joined in. I wish you could hear the ones left behind sing 'Take Me Back to Dear Old Blighty' as the lucky ones who are going home are carried out on stretchers. Tommy is an awfully good sport, you know, and laughs over his troubles more often than he weeps over them."

Her letter continues in that mood and shows clearly the fascination which the work held for her, despite its dangers and hardships.

Miss Colquhoun was discharged in August, 1919, returning to 45th Street.

Miss Anne M. Carlton, Service Secretary of the Cleveland Wire Division, was closely associated with Miss Colquhoun during her career as an army nurse. Miss Carlton entered the Lakeside Unit of the American Nurses Corps May 5th, 1917, in Cleveland, and in France was stationed at American Base Hospital No. 4 and at the British Expeditionary Force General Hospital No. 9. Miss Carlton's most interesting experience was "returning to the United States," but her thorough devotion to her army work can be readily understood by anyone who reads the following extract from a letter written "Somewhere in France" in July, 1917.

"We are very busy of course, but we like it—I can't tell you how much—the people, the country and everything. We are so happy to be really in this big game that nothing else really matters. We work very hard from nine to twelve hours each day, and then we have to be within call. We play as hard as we work. I wish I could tell you everything, but we can write only about the play part. We hear nothing but war, war, war, but I don't believe we have a single fear in the world."

The spirit of fearlessness mentioned by Miss Carlton was characteristic of the National's overseas nurses. They were all so interested in their work, so mindful of the suffering and weal of their patients, that their own safety was never uppermost in their minds. They tackled an exacting and important service; performed it thoroughly and cheerfully; and proved—insofar as individual records could prove it—that American womanhood can stand the test of danger and personal deprivation as magnificently as Yankee manhood.

The National and Its Service Men

The foregoing pages register the service of a majority of those who represented the National Lamp Works in the World War. These records in some instances may seem exasperatingly brief but this fact is easily explained. The average American soldier went into war with a set determination to give his best efforts to the struggle and with the thought of getting the affair over within the shortest possible time. Military service meant supreme effort and, on the part of many, extreme hardships and suffering. When the war was won, action was followed by reaction and more than one man desired to wipe entirely from his mind the miseries and unpleasant events he had experienced. Modesty prevented others from giving fuller details of their military career and in these cases, too, one must read between the lines, remembering that the service which the lad rendered his country is not to be measured by the few bare facts recorded in this volume.

A considerable number of National men were still in government employ at the time our volume went to press. This accounts for the omission of certain service records which some of our readers may be particularly interested in. Wherever possible, information has been solicited from these men, but in some instances, as they moved from camp to camp, it became impossible to trace them to their latest addresses. A list of the National employees in service on January 1st, 1920, may be taken from the Roll of Honor appearing on page 147. The asterisks denote those in service at that date. This number comprises about twelve per cent of the National's contribution in manpower to the war. Of those discharged from service about 65 per cent returned to the National. This figure illustrates remarkably well the bond of harmony prevailing between the organization and its men. The list of National men from whom no service information was received may also be found by referring to the Roll of Honor at the end of this Part. They are denoted by the mark §.

NATIONAL'S ATTITUDE TOWARD THE RETURNED SERVICE MAN

The National's attitude toward the returned soldier is amply illustrated in Terry and Tremaine's General Letter 1138, of November 11th, 1918.

"Our managers and other employees have given a hearty response to all requests that we have made for their assistance in war work. It has enabled us to fulfill the responsibility that we have felt for the war work of our organization as a whole. In all war endeavors our organization has made a splendid showing, and we believe that our employees have shown a higher degree of patriotism than have the employees of most other organizations.

"Probably none of us has done everything that was possible, or that he should have done, for when our American boys gave up their homes and their positions and went away to fight for us and others, they made real sacrifices, and few of us have done more than to submit to a few unimportant self-denials. Our boys did more than to earn our gratitude. It is a big debt that we owe them. The best way for us to pay this debt is to assist them so that they may make their lives the most useful, and retain the greatest amount of self-respect. Some of them may have temporarily lost their interest in useful civil occupations, or there may be difficulty in finding positions that correspond to their abilities and make the best use of their talents. Some will have lost limbs, and we must see that they are supplied with the very best artificial substitutes, and that care is taken in their re-education, until they are fitted for useful occupations. We may occasionally find those who, because of discouragement or the acquirement of unfortunate habits, will not readily respond to our endeavors. We must remember that their attitude has nothing to do with the fulfilling of our obligation, which is to restore to them as nearly as possible what they have given up for us. We must have consideration, tact and persistency until we have accomplished our part.

"Our policy with respect to this matter will be to make ourselves responsible for the return to useful life (not merely supplying them with 'jobs'), of a larger number of young men than the number that left our employ to engage in the war. As far as practical, we will take those who left our employ and restore them to positions at least equal to those that they held when they left us. We shall appoint some one who will make this whole subject his sole responsibility, until it is fully accomplished. (*Note.—Mr. J. E. Kewley was so appointed.*)

"The work of reconstruction and adjusting ourselves to normal conditions will be an immense task, and will gradually be taken in charge by the different governments, but this cannot be done in a moment. So long as there is work to do we must continue our interest, and this is particularly true of the care and attention of soldiers. We shall expect to continue seeking for such opportunities as our organization is fitted to undertake, and we shall count upon the continued loyal support of our managers and our employees."

THE ATTITUDE OF THE RETURNED SERVICE MAN

The ex-service man has embedded in his heart recollections of the support accorded him by those who stayed at home while he did his bit in uniform. Those individuals and concerns which backed him to the limit are thought of as true partners in helping to defeat the monster of militarism. Those whose support was half-hearted, or in other words of negative value, can scarcely expect to receive the hearty approval of boys who willingly sacrificed themselves for others.

ATTITUDE TOWARD THE NATIONAL

National men who were in service—and these lines are written by one of them—appreciate the support accorded by the National organization and by those of its employees who were unable to enter the military establishment. A few of the many ways in which the National Lamp Works backed up the boys are enumerated below, not because it invites praise for its efforts but because the war veterans acknowledge the spirit in which these things were done:

1. The National dedicated its efforts to winning the war. Making lamps was secondary.
2. The organization subscribed liberally to all Liberty Loans, contributed abundantly to relief funds and backed up the government in all other financial undertakings.
3. It gave willingly of its employees' time to make all government activities successful.
4. Offered re-employment to those returning from service.
5. National Divisions and Departments remembered their men in service throughout the year by many kind favors. For example, Minnesota Mazda had a committee appointed to take care of its people in service, furnishing them with information, news items, candy, gum, cigarettes and the like. A mailing schedule was established, and each week something was forwarded to show the absent members of the organizations that they were remembered.
6. A month's pay was given to every employee upon entering service, providing he had been in the Company's employ six months.

ATTITUDE TOWARD THE GOVERNMENT

The new civilian is a far better American today than when he first donned military attire. Months of strenuous service in which he thought America, talked America and gave his whole existence to America, have inculcated in him firmly the principles for which America stands, so that today he loves everything that builds for true Americanism and hates everything which opposes it.

The United States Government has done much, and will continue to do much, for its World War veterans. Likewise, the latter are doing a great deal for Uncle Sam. Organizations of men who saw service in 1917-18 are lending thought and diligent effort to the problems which confront us today. Chief among these service organizations may be cited the American Legion, whose members have been active in quelling riots and spreading the principles on which our republic is founded. The formation of East Cleveland Post, No. 163, which was organized wholly through the efforts of ex-service men at Nela Park, may be interesting to our readers.

THE AMERICAN LEGION

In war and out of war, one hundred per cent American! That is the slogan to which this body of honorably discharged soldiers, sailors and marines have pledged themselves. In war they fought for justice, freedom and democracy. Today they are upholding and perpetuating the fruits of their victory and are receiving the encouragement of all America-loving people.

Early in September, 1919, several ex-soldiers at Nela Park decided to organize an American Legion post to which the fellows at Nela and East 152nd Street could belong. Russell P. Askue (see page 40) was extremely active in interesting others in the movement. Colonel F. M. Dorsey, Chief of the Development Division of the Chemical Warfare Service, was called upon and, being already familiar with the aims of the Legion, was more than willing to do his bit. At Colonel Dorsey's request Colonel J. R. McQuigg, commander of the 112th Engineers, agreed to address National men at Nela Park, September 19th, on the American Legion. Notices of this meeting were posted at Nela Park, E. 152nd

St., and E. 45th St. and a large number of service men were in attendance.

At the close of Colonel McQuigg's spirited talk, given in the lecture room of the Engineering Building, Chairman Dorsey called a meeting for September 25th. At this later meeting the following temporary officers were elected.

Ed. Du B. Stryker, Chairman.

W. W. Loveland, Secretary.

The temporary officers presented the application for a post charter, which was approved and granted September 30th, 1919, as East Cleveland Post, No. 163. On the same date Messrs. Leroy Lemon, M. H. Keys and H. W. Vanderwerf were chosen to represent the Post in the county council.

At a subsequent meeting, held October 20th, 1919, the following permanent officers were elected for the year ending October 20th, 1920.

Leroy Lemon (of the Ohio Blower Co.)—Post Commander.

Ed. Du B. Stryker—Post Vice-Commander.

M. D. Cooper—Post Adjutant.

J. W. Dunbar—Post Historian.

F. W. Hild—Post Finance Officer.

D. C. Hughes—Post Chaplain.

The following members were appointed as an executive committee to serve with the foregoing officers:

Messrs. L. E. Smith, F. M. Dorsey, J. F. Donovan, O. L. Brunner and D. C. Herrick.

East Cleveland Post No. 163 is not limited to Nela employees; any honorably discharged service men and women are eligible and eagerly welcomed to membership. Regular meetings are held in the lecture room at Nela Park. As of May, 1920, 168 men were enrolled in this post.

So ends the story of the five hundred and ninety-seven National men and women who gave themselves to the cause of humanity by entering government service during the dark days of 1917-1918. A complete account of their service can never be written, except as these patriots have already written it in their deeds.

ROLL OF HONOR

Below are listed the 597 men and women who left their civilian employment with the National Lamp Works and entered the forces of the United States or her allies during the period of the war. The asterisk (*) denotes those who, according to our best information, were in service as late as January 1, 1920. The section-mark (§) denotes those concerning whose service no detailed information could be obtained by the editors of this volume. The dagger (†) denotes those who died in the service. Those marked (N) were in the Navy; all who are not otherwise marked were in the Army.

NAME	RANK WHEN DISCHARGED	DEPARTMENT OR DIVISION BEFORE ENTERING SERVICE.
Abrams, Harold M.	Ordinary Seaman (N)	Cleveland Wire.
Acker, William A.	§	Cleveland Wire.
†Allen, John S.		Returned Lamp Inspection.
Allen, Louis B.	Private, 1st Class	Nela Operating.
Allsopp, William	Sergeant	Equipment Development.
Anderson, Earl A.	Lieutenant, senior grade (N)	Engineering.
*Anderson, George	§	Rhode Island Glass.
Anderton, Herbert L.	Corporal	Rhode Island Glass.
Arrinda, A.	§Private	Lamp Equipment.
*Ashdown, Gerald J.	§	Cleveland Wire.
Ashford, Miss Frances	Nurse	St. Louis Mazda Lamp.
Askue, Russell R.	Private (Officer Candidate)	Ivanhoe-Regent Works.
*Atchley, Shird P.	(N)	Ohio Division.
Austin, Frank	§	Niles Glass.
Baeckler, Walter	Private	Youngstown Mazda.
Baker, Robert F.	1st Lieutenant	Engineering.
Baldauf, Harry E.	Wagoner	Euclid Glass.
Ballou, Lance C.	2nd Lieutenant	Bryan-Marsh (Central Falls).
Bard, Rudolph T.	Sergeant	Nela Press.
Barker, Altamont S.	Corporal	Engineering.
Barry, Ovide L.	Private	Rhode Island Glass.
Beake, Gower L.	Private, 1st Class	Niles Glass.
Beals, Gillson W.	2nd Lieutenant	Commercial Development.
Beauregarde, Louis	§(N)	Central Falls Mazda Lamp.
Bechhold, Myron J.	Private, 1st Class	Nela Operating.
Beck, Horace W. Jr.	Private	Columbia Lamp.
Beckman, Elmer H.	Private, 1st Class	Chemical Laboratory.
Bedaka, Andrew	§	Cleveland Wire.
Belford, John	§Private	Engineering.
Benoit, Dona	§	Rhode Island Glass.
Berry, Clarence J.	1st Lieutenant	Engineering.

NAME	RANK WHEN DISCHARGED	DEPARTMENT OR DIVISION BEFORE ENTERING SERVICE.
Beutel, Frederick	Yeoman (N)	Transportation.
Billington, Joseph	§	Rhode Island Glass.
Billitter, Lewis	§	Niles Glass.
Birster, Charles M		Lamp Equipment.
Boehning, William C	Private	Minnesota Mazda Lamp.
Boggis, H. P	§	Engineering.
Boiles, Frank H	Private (Marine Corps)	Youngstown Mazda Lamp.
Boucher, Edward	§(N)	Central Falls Mazda Lamp.
Bouvier, Albert E	Cook	Central Falls Mazda Lamp.
Bova, Thomas	§	Providence Base Works.
*Branch, Frank	§	Lamp Equipment.
Brennan, Edward	Mechanic	St. Louis Mazda Lamp.
Briggs, Walter E	§	Central Falls Mazda Lamp.
Broadbent, William H	Private	Euclid Glass.
†Brooks, Enoch E	§Private	Niles Glass.
Brooks, George H	Sergeant	Niles Glass.
Brown, Andrew J	2nd Lieutenant	Federal Miniature(NewYork)
Brown, Edward	§	Cleveland Wire.
Brown, L. C		Engineering.
Brown, Norman A	§	Rhode Island Glass.
Brown, Roland S	Corporal	Providence Base Works.
Brown, William D	Corporal	Ohio Division.
*Browning, Parker	§(N)	Lamp Equipment.
Brundage, Arthur	§(N)	St. Louis Mazda Lamp.
Buel, Edward A	2nd Lieutenant	Commercial Development.
Bulla, Oscar M	Private	Youngstown Mazda Lamp.
Burdette, Donald	§	Engineering.
Burdick, Lewis E	Private, 1st Class	Central Falls Mazda Lamp.
Burns, James B	Private	Niles Glass.
Burns, John J	Carpenter's Mate, 3rd Class (N)	St. Louis Mazda Lamp.
Butler, Clifford		Cleveland Wire.
Cadle, Ivor H	Ordinary Seaman (Merchant Marine)	Nela Lamp.
Callahan, Ernest L	Machinist's Mate, 1st Class (N)	Providence Base Works.
Cameron, Stanley G.	§Private	Lamp Equipment.
Cannon, John F	Private	Niles Glass.
Cardinale, Joseph	Private, 1st Class	Providence Base Works.
Carlson, Albert B	Machinist's Mate, 1st Class (N)	Providence Base Works.
Carlton, Miss Anne M		Cleveland Wire.
*Carroll, James	§	Rhode Island Glass.
*Carter, John	§(N)	Niles Glass.
Casey, Edward P	Apprentice Seaman (N)	Niles Glass.
Castrovillari, Cosmo	Private, 1st Class	Providence Base Works.

NAME	RANK WHEN DISCHARGED	DEPARTMENT OR DIVISION BEFORE ENTERING SERVICE.
Caswell, Sydney C	1st Lieutenant	Nela Specialties.
Catano, Paul		Nela Press.
Catatto, Nick		Euclid Glass.
Catugno, Antonio	§	Providence Base Works.
Chadwick, Theodore G.		Ohio Division.
Chapman, Earl J.	§	Lamp Equipment.
Chapman, George J.	2nd Lieutenant	Large Lamp Sales
Chasson, Emil	§	Rhode Island Glass.
Chiconi, Arthur H.	Troop Mechanic	Lamp Equipment.
†Clancy, George C		Euclid Glass.
Clark, Clarence	Bugler, 1st Class	Lamp Equipment.
*Cleal, Ray	§	Niles Glass.
*Coates, Lawrence	§	Cleveland Wire.
*Cobb, Percy W	Captain	Nela Research Laboratory.
Coburn, Charles	§	Niles Glass.
Colcord, Fred		Oakland Mazda Lamp.
Colquhoun, Emily M		45th St. Properties.
Coman, Lucien D. Jr	Corporal (flying rating)	Nela Research Laboratory.
†Comisky, Lewis M		Ivanhoe-Regent Works.
Commery, Eugene W	Civilian Worker	Engineering.
Compton, Ralph O	1st Lieutenant	Engineering.
Conte, C.	§	Providence Base Works.
Conway, T. C.	§	Youngstown Mazda Lamp.
Cook, Howard M	Ensign (N)	Nela Specialties.
*Cook, William W.	§	Niles Glass.
Cooper, Marion D	2nd Lieutenant	Engineering.
†Coughlin, Robert T.	Corporal	Cleveland Wire.
Cousineau, Arthur A.	Private	Central Falls Mazda Lamp.
Cover, Leo G.	Captain	Cleveland Wire.
Coy, Ralph W.	§	Euclid Glass.
Cress, Phil J	§	Realty.
*Crew, Bert.	§	Lamp Equipment.
Crossland, Elmer R.	Private (Marine Corps)	Central Falls Mazda Lamp.
Cunningham, Albert		Oakland Mazda Lamp.
Cunningham, Thomas J.	§	Nela Operating.
Curth, Ralph		Nela Research Laboratory.
Dana, Junius	Private, 1st Class	Cleveland Carbon Filament.
Dargie, Arthur	§	Rhode Island Glass.
Davies, James L	Chief Machinist's Mate (N)	Equipment Development.
Davis, Robert W.	Lieutenant, junior grade (N)	Large Lamp Sales.
Davis, W. G.	§	St. Louis Mazda Lamp.
Dawson, Carl H.	§Civilian Worker	Standardizing.
*Dearborn, William	§	Cleveland Wire.

Name	Rank When Discharged	Department or Division Before Entering Service.
*Debasky, Anthony	§	Cleveland Carbon Lamp.
Derry, Ernest N	Private	Central Falls Mazda Lamp.
Dick, Paul	§	Cleveland Flashlight Lamp.
Dieckow, Walter W	Private	Lamp Equipment.
Diehl, W	§	Engineering.
Dipietro, Cormine		Nela Operating.
Doane, Le Roy C	1st Lieutenant	Ivanhoe-Regent Works.
†Doll, James W		Loudon Glass.
Donovan, J. F	Captain	Equipment Development.
Doran, Edward L	Private, 1st Class	Niles Glass.
Dorsey, Frank M	Colonel	Lamp Development.
Doty, Charles C	Private	Buckeye Electric.
Doyle, J. M		Cleveland Wire.
Dubinsky, John H	§	Niles Glass.
Duff, J. Roy	§Captain	Chief Accounting.
Duff, Nicholas V	Private	Returned Lamp Inspection.
Du Gar, Fred W	§Ensign (N)	Engineering.
Dunbar, Edward V	§ (N)	Engineering.
Dunbar, J. Watson	Cadet Flyer	Engineering.
Duncan, Robert N	Private, 1st Class	Miniature Bulb.
Dunn, James H	Private	Rhode Island Glass.
Dunnigan, Raymond A	Sergeant	Niles Glass.
Durst, Paul H	Private	Youngstown Mazda Lamp.
Eddy, John L	Private	Nela Operating.
*Edwards, Edward S	§ (N)	Providence Base Works.
Egeler, Carl Edward	Lieutenant, senior grade (N)	Engineering.
Ellis, Herbert W	Sergeant, 1st Class	Engineering.
Endress, Clarence H	§2nd Lieutenant	Standardizing.
Ensign, Leland R	Corporal	Ohio Division.
*Evans, George A	§	Providence Base Works.
Evans, Roy H	Private	Miniature Lamp Sales.
Exall, John	§	Cleveland Mazda Lamp.
Fahy, Miss Beatrice A	Head Surgical Nurse	Minnesota Mazda Lamp.
Fahy, Raymond	§ (N)	Minnesota Mazda Lamp.
Falge, Robert N	Ensign (Naval Aviation)	Engineering.
*Fatica, John	§	Miniature Bulb.
Fatigo, Mike	§	Cleveland Mazda Lamp.
Feder, Milton S	§	Central Falls Mazda Lamp.
Fee, Francis T	Private	St. Louis Mazda Lamp.
Felske, Elmer	Private	Cleveland Wire.
Finnigan, Frank R	Private	Niles Glass.
Finnigan, Harry		Niles Glass.
Firm, David O	Private	Euclid Glass.
Firman, Harry	§ (N)	St. Louis Mazda Lamp.
Fisher, Fred T	§	Euclid Glass.
*Fisher, Grover L	§	Nela Operating.

NAME	RANK WHEN DISCHARGED	DEPARTMENT OR DIVISION BEFORE ENTERING SERVICE.
Foley, Dennis D	Private, 1st Class	Rhode Island Glass.
Forrest, Alphonse W	§	Central Falls Mazda Lamp.
Foster, Charles		Ohio Division.
Fotte, Carmelo		Providence Base Works.
Fournier, Joseph R	Seaman, 2nd Class (N)	Rhode Island Glass.
Frear, Perry M	1st Lieutenant	Nela Specialties.
Frechette, George	§	Rhode Island Glass.
Freer, Clyde P	(Marine Corps)	Ohio Division.
Fricke, Walter C	Yeoman (N)	Columbia Lamp.
Fried, Monroe J	Corporal	Nela Press.
Fullerton, Richard		Cleveland Wire.
Gage, John H	1st Lieutenant	Fostoria Incandescent Lamp.
Gaiser, Erich	§	Cleveland Wire.
†Gardner, Jesse S		Ohio Division.
Garrison, Ralph H	2nd Lieutenant	Bryan-Marsh (Chicago).
*Gerlach, Irving H	§	Bulb and Tubing.
Getson, Harry	(N)	Ohio Division.
Gibbs, Arthur D	Private, 1st Class	Niles Glass.
Gilbert, Herschel R		Standardizing.
Gilmour, Fred		Niles Glass.
*Gionannucci, Savior	Private	Providence Base Works.
Glasser, Joseph	§	Engineering.
Glave, Herman		Cleveland Wire.
*Goetz, Joe	§	Illinois Miniature Lamp.
Gormly, George C	Apprentice Seaman (N)	Engineering.
Gorton, Daniel	§	Rhode Island Glass.
*Graves, G. S	§	Lamp Equipment.
Gregory, Fred S	Sergeant	Ohio Division.
Greisen, Anthony S	Corporal	Minnesota Mazda Lamp.
*Griffin, James J	§ (N)	Niles Glass.
Griffin, Patrick	Private	Rhode Island Glass.
Griffiths, Ernest J	§Sergeant	Niles Glass.
Grooms, William	§Private, 1st Class	Loudon Glass.
Grossberg, Maurice	§	Cleveland Wire.
Guntner, Frank G	Private, 1st Class	Lamp Equipment.
Guntner, Jay A	Private, 1st Class	Lamp Equipment.
Gustafson, Evald	Private	Euclid Glass.
Haefeli, Edwin J	Civilian Employee	Lamp Development.
Hagan, John H	Sergeant	Providence Base Works.
Hagensen, Theodore A		Minnesota Mazda Lamp.
Hall, Walter	Captain	Bryan-Marsh (Chicago).
Hamel, Louis A	Private	Central Falls Mazda Lamp.
Hamey, Joseph V	Private	Euclid Glass.
†Hammell, Clarence	Private	Oakland Mazda Lamp.
Hamrich, Paul R		Lamp Equipment.
Handel, Albert	Private	Youngstown Mazda Lamp.
Handrigan, Joseph L	Private	Central Falls Mazda Lamp.

NAME	RANK WHEN DISCHARGED	DEPARTMENT OR DIVISION BEFORE ENTERING SERVICE.
Hankison, George E	Private, 1st Class	Credit.
Hannemann, Joseph J	Corporal	Bryan-Marsh (Chicago).
Hannemann, William F	Sergeant	Bryan-Marsh (Chicago).
Hardin, Lorraine G	1st Lieutenant	Engineering.
*Harris, Walter L	§	Lamp Equipment.
Harris, William	§	Loudon Glass.
†Hartman, Edward F		St. Louis Mazda Lamp.
Hartman, Roger F	Sergeant	Puritan Refilled Lamp.
Harwood, John W	Private	Lamp Equipment.
Hathaway, George E	Sergeant	Nela Research Laboratory.
Hayman, George B	Sergeant	Cleveland Miniature Lamp.
Henderson, Wayne G	Private	Chemical Laboratory.
Hennecke, Robert C	Sergeant, 1st Class	Federal Miniature (Chicago).
Hennessey, John F	Private	Rhode Island Glass.
Herkner, Walter F	Ordinary Seaman (N)	Cleveland Carbon Lamp.
Herman, Charles	Seaman, 1st Class (N)	Miniature Bulb.
Herrick, DeWitt C	Lieutenant, junior grade (N)	Engineering.
Herrmann, Henry	§	Credit.
*Hertzog, Thomas	§	Lamp Equipment.
Hild, Frederick W	Ensign (N)	Nela Lamp.
Hill, Shelden G	Private	Puritan Refilled Lamp.
Hilling, William G		Cleveland Wire.
*Hilton, J	§	Rhode Island Glass.
Himeon, Everett W	Corporal	Central Falls Mazda Lamp.
Hitch, Horace M		Statistical.
†Hitchcock, Datzel F	Marine Engineer, 3rd Class (N)	Engineering.
Hoerlein, Benjamin H	Sergeant	Buckeye Electric.
Holm, Charles L	2nd Lieutenant	Engineering.
Holmes, Wayne Moore	2nd Lieutenant	Engineering.
Holt, Paul A	2nd Lieutenant	Ohio Division.
Horr, Edward N	Captain	Engineering.
Howatt, Earl		Oakland Mazda Lamp.
Hughes, Dale C	1st Lieutenant	Lamp Development.
Hulbert, Thorne L	§ (N)	Lamp Development.
Hull, Edwin J	Captain	Cleveland Wire.
Hunsicker, Walter D	Seaman, 2nd Class (N)	Colonial Electric.
Ibele, Walter C	(N)	Lamp Development.
†Ingram, Joseph R		Loudon Glass.
Janidlo, Steve	Private	Lamp Equipment.
Jeffries, Paul J	Private	Minnesota Mazda Lamp.
Jensen, Holgard V	§	Minnesota Mazda Lamp.
Jewell, Theodore S	Private	Nela Operating.
*Johnson, Harry M	Captain	Nela Research Laboratory.
Johnson, Hugo	Private, 1st Class	Euclid Glass.
Johnson, Orval E	Musician, 2nd Class	Oakland Mazda Lamp.

NAME	RANK WHEN DISCHARGED	DEPARTMENT OR DIVISION BEFORE ENTERING SERVICE.
Johnson, Oscar E	Private, 1st Class	Lamp Equipment.
Johnson, Roy	§ (N)	Minnesota Mazda Lamp.
Johnson, Wilbur M	2nd Lieutenant	Engineering.
Jones, Benjamin	Private (British Army)	Ohio Division.
Jones, Charles H		Niles Glass.
*Jones, Granville W	§	Illinois Miniature Lamp.
Jones, Robert		Niles Glass.
Jones, William D		Ohio Division.
†Judd, Francis L	Private	Oakland Mazda Lamp.
Kavanaugh, William J	Private	Engineering.
Kaye, Elmer A	Corporal	Euclid Glass.
Kaye, Roy P	Private, 1st Class	Euclid Glass.
†Kearney, Frank J	Sergeant	Niles Glass.
Keenan, W. Carroll	Sergeant	Nela Operating.
Keiser, Elmer G	Private	Loudon Glass.
Keiser, Guy	Private, 1st Class	Niles Glass.
Keister, Baird	§	Engineering.
Keister, Lowell M. Jr	Private	Realty.
Kelley, James	§ (N)	Oakland Mazda Lamp.
Kelley, William B	§	Rhode Island Glass.
Kelly, Walter A	Private	Euclid Glass.
Kent, Lee C	2nd Lieutenant	Engineering.
Kenyon, Bradford H	2nd Lieutenant	Providence Base Works.
Kesler, Charles C	Private, 1st Class	Loudon Glass.
Ketch, James M	2nd Lieutenant	Engineering.
Khoury, Nicholas	§	Nela Lamp.
Kilroy, Edward A	§	Realty.
King, Henry	§	Rhode Island Glass.
King, Walker J		Lamp Development.
Kirwin, William J	Carpenter's Mate, 3rd Class (N)	Central Falls Mazda Lamp.
Knallay, William	§	Euclid Glass.
Knealy, Willis M	§	Cleveland Wire.
*Kois, Steven	§	Rhode Island Glass.
Komick, John	Private	Nela Operating.
Koons, David F	Corporal	Euclid Glass.
Kopecky, Frank E	Private	Shelby Lamp.
Kremm, Arthur L	Sergeant, 1st Class	Euclid Glass.
*Kubiski, John J	§ (N)	Rhode Island Glass.
Lacasse, Arthur W	Fireman, 2nd C. (N)	Rhode Island Glass.
Lane, William		Cleveland Wire.
Larkman, Rowland E	Private	Cleveland Mazda Lamp.
Larremore, Floyd M	Sergeant	Euclid Glass.
Laufketter, Fred C	Production Engineer	Fostoria Incandescent Lamp.
*Lawton, L	§	Rhode Island Glass.
Lea, Herbert S	§	Trumbull Mazda Lamp.
Leach, O. M	§ (N)	Bryan-Marsh (Detroit).

Name	Rank When Discharged	Department or Division Before Entering Service.
*Ledeger, Martin	§	Nela Operating.
Lehmann, E. E	§Private	Standardizing.
Leighton, Roy L	Master Signal Electrician	Lamp Equipment.
Lemaire, Joseph	Bugler	Rhode Island Glass.
Lemr, Charles	Private	Nela Lamp.
*Lenney, James	§	Niles Glass.
Leonard, Arthur	§	Lamp Equipment.
Levitt, William T	Sergeant, 1st Class	Ohio Division.
Lightner, Clyde	(Marine Corps)	Oakland Mazda Lamp.
*Lincoln, R. D	§ (N)	Niles Glass.
Lindblom, Sven O	Corporal	Providence Base Works.
Lindsay, James C		Cleveland Wire.
Linerode, Charles C		Auditing.
†Lintz, Noble C		Detroit Miniature Lamp.
Lippman, F. D	§	Youngstown Mazda Lamp.
Loucks, Roxy	§	Euclid Glass.
Loveless, Carl	§	Trumbull Mazda Lamp.
Lucas, Leo	§	Niles Glass.
*Lunberg, John	§ (N)	Loudon Glass.
Lynch, George H	Apprentice Seaman (N)	Puritan Refilled Lamp.
Lyons, John J	Private, 1st Class	Euclid Glass.
Lyons, Lester W	Sergeant	Sunbeam Lamp (New York City).
*Madigan, Thomas	§	Niles Glass.
Madison, Elisha P	Private	Rhode Island Glass.
Maganini, Arthur	§ (N)	Oakland Mazda Lamp.
Mahoney, Charles	§	Niles Glass.
Mahoney, James	§	Niles Glass.
Mall, Frank	§	Euclid Glass.
Marcogliese, Vitaliono	§	Providence Base Works.
Marks, D. W	§	Euclid Glass.
*Marshall, Floyd C	§	Providence Base Works.
Marshall, Herman H. P	Private, 1st Class	St. Louis Mazda Lamp.
Martin, Earl T	Corporal	Illinois Miniature Lamp.
Martin, Ward F	Private	Nela Lamp.
Martine, J. Leon	§	Columbia Lamp.
Masonbrink, Herbert C	Private	Lamp Equipment.
*Mastronardi, John	§	Providence Base Works.
Mattern, Walter R	Corporal	Nela Operating.
Mattis, Harry	Private	Equipment Development
Mayer, Frank	§	Nela Operating.
Mayhew, William	§	Rhode Island Glass.
McCartney, Jack	§	Oakland Mazda Lamp.
McDermott, Robert J	§Private	Providence Base Works
McElhaney, Harry H	§	Loudon Glass.
*McFarland, Edward J	§ (N)	Miniature Bulb.

NAME	RANK WHEN DISCHARGED	DEPARTMENT OR DIVISION BEFORE ENTERING SERVICE.
McGrath, William C.	Corporal	Columbia Lamp.
*McKeown, F.	§	Rhode Island Glass.
*McShane, M.	§	Lamp Equipment.
Merrick, Joseph S.	Private, 1st Class.	Loudon Glass.
Merrick, Walter F.	Private	Loudon Glass.
Metz, J.	§	Lamp Equipment.
Metzger, Francis C.		Lamp Equipment.
Metzger, R.	§	Lamp Equipment.
Michelson, S. Emil	Musician, 1st Class.	Youngstown Mazda Lamp.
Miller, Ormsby D.	(N)	Illinois Miniature Lamp.
Miller, Walter M.	Oiler (U. S. Shipping Board)	Oakland Mazda Lamp.
Minncuci, Sylvester	Private	Providence Base Works.
Mitrovich, Joseph M.	Private	Ohio Division.
Molloy, Joseph A.	Private	Nela Operating.
Molloy, Thomas J.	Corporal	Nela Lamp.
Molloy, Richard	(Canadian Army)	Cleveland Wire.
Monaco, Giovani Del	(N)	Providence Base Works.
Monahan, Andy	Private	Niles Glass.
Mondi, S.	(N)	Providence Base Works.
Montagano, Arthur		Providence Base Works.
Moore, Laura E.	Nurse	Nela Operating.
Moredock, Albert R.	ChiefStorekeeper(N)	Columbia Lamp.
Morgenstern, Herbert J.	Private, 1st Class.	Standardizing.
*Morris, Dewey	§	Cleveland Wire.
Morrison, Carrol B.		Oakland Mazda Lamp.
Morrison, William E.	Lieutenant, junior grade (N)	Cleveland Miniature Lamp
Moss, Septie	§	Niles Glass.
Motto, Charles J.	§	Cleveland Wire.
*Muir, Leland J.	§	Law.
Mullarky, Michael T.	Sergeant	Youngstown Mazda Lamp.
Murphy, Howard H.	Private	Euclid Glass.
Murphy, Patrick	Private	Euclid Glass.
Murray, John C.	Private	Buckeye Electric.
Murtaugh, James		Niles Glass.
Myers, George W.	Private	Euclid Glass.
Mylechraine, R.		Cleveland Miniature Lamp.
Nash, Ralph C.	2nd Lieutenant	Peerless-Brilliant Lamp
Nesbitt, Alfred	§ (N)	Niles Glass.
Newmeister, R.	§	Lamp Equipment.
Nibeck, George M.	Corporal	Euclid Glass.
Nick, Worbert	§ (N)	Loudon Glass.
Niehus, Oswald H.		Cleveland Wire.
Niess, George		Niles Glass.
Nixon, Crawford G.	2nd Lieutenant	Standardizing.
Norris, George E.	Private	Youngstown Mazda Lamp.
Norton, Glenn E.	Corporal	Ohio Division.

NAME	RANK WHEN DISCHARGED	DEPARTMENT OR DIVISION BEFORE ENTERING SERVICE
Nottage, Charles T.	Private, 1st Class.	Lamp Equipment.
Nungesser, Ralph A.	Lieutenant, junior grade (N)	Commercial Development.
O'Dea, Richard	§	Lamp Equipment.
†O'Donnell, Michael		Nela Operating.
O'Grady, Charles F.	Sergeant, 1st Class.	Central Falls Mazda Lamp.
Olson, Harold A.	Ensign (N)	Engineering.
Ostiguy, Wilfred	§	Rhode Island Glass.
Owen, Fred B.	2nd Lieutenant.	Oakland Mazda Lamp.
Paine, Russell A.	Private	Minnesota Mazda Lamp.
Palermo, Joseph	Private, 1st Class.	Lamp Equipment.
Pantonlis, Gret	§	Trumbull Mazda Lamp.
Papenfuse, Charles A.	§	Euclid Glass.
†Parker, Leslie W.	(N)	Minnesota Mazda Lamp.
*Parmelee, Luther	§	Nela Lamp.
Parshall, Ray W.	Corporal (Marine Corps)	Lamp Development.
Paterson, Lorenzo W.	Seaman, 2nd C. (N)	Cleveland Wire.
Pearson, Joseph	§	Cleveland Wire.
†Peffer, Harry E.		Niles Glass.
Pelton, Lawrence P.		Ohio Division.
Perry, Raymond	1st Lieutenant	Ivanhoe-Regent Works.
*Persiani, Antonio	§	Providence Base Works.
*Petas, Nick	§	Rhode Island Glass.
Peters, Walter L.	2nd Lieutenant.	Illinois Miniature Lamp.
Petosky, Nick	Cook	Euclid Glass.
*Pettit, Marvin	§	Bryan-Marsh (Chicago).
Phillips, Chester	§	Oakland Mazda Lamp.
Pierce, Harold E.	Private	Minnesota Mazda Lamp.
Pindell, William H. Jr.	Captain	Sterling Electric Lamp.
Pion, Romeo F.	§	Rhode Island Glass.
Porter, Wilbur N.	Seaman, 1st Class (N)	Nela Operating.
Potteiger, Hurley	Corporal.	Loudon Glass.
Potter, Joseph	Private	Lamp Equipment.
Powers, Alman	§	Detroit Miniature Lamp.
Price, Le Roy F.	§Private	Engineering.
Price, Wayne F.	Wagoner	Euclid Glass.
Prince, Harold E.	Seaman, 2nd Class (N)	Cleveland Wire.
Prunckunog, L.	§	45th St. Properties.
Pupke, William H.	(Marine Corps)	Fostoria Incandescent Lamp.
Purser, Raymond C.		Ohio Division.
Putka, Joe	§	45th St. Properties.
Quinlan, Herbert E.	Chief Quartermaster (Naval Aviation)	Nela Lamp.
*Quinn, Raymond	§(Marine Corps)	Niles Glass.
Racey, J. C.		Cleveland Wire.
*Rayl, Robert W.	§	Lamp Equipment.

Name	Rank When Discharged	Department or Division Before Entering Service.
*Real, Frank	§	Niles Glass.
Reed, William J	Private	Illinois Miniature Lamp.
Reider, Kenneth G	Sergeant	Glass Technology.
Reisinger, James C	§ (N)	Engineering.
Rensel, John V	Private	Nela Lamp.
Rice, John	§	Engineering.
Rick, Joseph J	Sergeant	Sterling Electric.
Riendeau, Henry	§	Rhode Island Glass.
*Riser, Andrew J	§	Niles Glass.
Ritter, Forest L	Sergeant	Ohio Division.
Rodgers, Duke	§	Oakland Mazda Lamp.
Roffee, Arthur P	Boatswain's Mate, 2nd Class. (N)	Providence Base Works.
Ronan, N. T	§	Bryan-Marsh (Chicago).
Rosborough, William M.	1st Lieutenant	Shelby Lamp.
Ross, Gabriel J	§	Cleveland Mazda Lamp.
Ross, William	Private	Credit.
Rossington, Laurence	Private (Canadian Army)	Publicity.
Rossington, Wallace M.	Regimental Sergeant Major (Canadian Army)	Large Lamp Sales
Roth, Herman A	§ (N)	Realty.
*Rummell, Edward	§	Niles Glass.
Russell, M. H	Ensign (N)	Cleveland Wire.
Russell, John	§	Niles Glass.
Rust, Louis J	§Ensign (N)	Engineering.
Ryan, James E	Private	Niles Glass.
Ryan, John E	§	Law.
Sack, Edwin L		Lamp Equipment.
Sambol, Frank	(Serbian Army)	Lamp Equipment.
Samsel, Carl	§	Euclid Glass.
Samples, George E	§	Minnesota Mazda Lamp.
Sanborn, Norman P	Ensign (N)	Engineering.
Sankey, T. Harold	Private	Nela Operating.
Santangelo, Domenico	Private	Providence Base Works.
Santoro, Emilio	Private	Providence Base Works.
Savage, Charles E	Private, 1st Class	Engineering.
Savage, Francis J	Private	Nela Press.
Savo, George	Chief Yeoman (N)	Law.
Scalley, William F	§	Rhode Island Glass.
*Schaefer, William W	Sergeant, 1st Class	Bryan-Marsh (Central Falls).
*Scharch, E. J	§	Nela Lamp.
Scharringhausen, Clyde	Private	Columbia Lamp.
Schiene, Anthony	§	St. Louis Mazda Lamp.
Schmoll, N	§	Euclid Glass.
Schroeder, William E	Private, 1st Class	Nela Press.
Schuler, Fritz	Corporal	Oakland Mazda Lamp.

Name	Rank When Discharged	Department or Division Before Entering Service.
Sealey, G. L.	§ (N)	Engineering.
*Sertell, Aloysious.	§	Niles Glass.
Shimonek, Edward R.	2nd Lieutenant.	Oakland Mazda Lamp.
Sincero, Vincenzo	Private.	Providence Base Works.
Skebe, M.	§	Euclid Glass.
Sliger, George D	Private	Auditing.
Sloan, R. M	§	Engineering.
Smith, Albert	Private	Rhode Island Glass.
*Smith, Albert	§	Cleveland Wire.
*Smith, Alonzo	§	Niles Glass.
Smith, Beryl S	Private	Lamp Equipment.
Smith, George F	Private	Chemical Laboratory.
Smith, George H	2nd Lieutenant.	Engineering.
Smith, Otto	§	Niles Glass.
Smith, Robert H.	Private	Minnesota Mazda Lamp.
Smith, Roy W.	§	Trumbull Mazda Lamp.
Smith, Sidney C.		Niles Glass.
Smith, Uhl M.	Master Engineer, senior grade.	Youngstown Mazda Lamp.
Smoots, Philips P	Private	Euclid Glass.
Snee, Bernard.	§	Rhode Island Glass.
Snouffer, John C	Private	Euclid Glass.
*Soder, Edward	§	Niles Glass.
Sotzen, Howard.	2nd Lieutenant.	Shelby Lamp.
Sponsler, Coursen W.	Corporal.	Bulb and Tubing.
Sproull, John R.	§	Euclid Glass.
Staggers, Elery	§Corporal	Loudon Glass.
Stambler, David	Private	Puritan Refilled Lamp.
Stark, Lawrence W	Sergeant	St. Louis Mazda Lamp.
Starn, Wayne E.	Private	Loudon Glass.
Steinhurst, William F.	Corporal	Loudon Glass.
*Stephan, Steve	Musician (N)	Cleveland Miniature Lamp.
Stock, John J.	Sergeant	St. Louis Mazda Lamp.
*Strang, John J.	§	Bryan-Marsh (Chicago).
Streng, E. C	§2nd Lieutenant	Engineering.
Sturrock, Walter.	1st Lieutenant	Engineering.
Sullivan, Arthur.	1st Lieutenant	Shelby Lamp.
Sullivan, Chester M.	Gunnery Sergeant (Marine Aviation)	Minnesota Mazda Lamp.
†Sullivan, James E.		Niles Glass.
Svec, John	§	Nela Operating.
†Swartz, Ray L.		Ohio Division.
Sweetland, A. A.	§ (N)	Youngstown Mazda Lamp.
*Sweed, Harry	§	Niles Glass.
Sykes, Wesley P.	§ Seaman, 2nd Class (N)	Cleveland Wire.
Tait, Howard J	Regimental Sergeant Major	Ivanhoe-Regent Works.

NAME	RANK WHEN DISCHARGED	DEPARTMENT OR DIVISION BEFORE ENTERING SERVICE.
Talbot, Ira D	Private	Equipment Development.
Tefft, Lincoln J.	Private	Administration.
*Terry, Kenneth	§	Nela Operating.
Teschke, Emil	Private, 1st Class	Lamp Equipment.
Theberge, Napoleon	§	Rhode Island Glass.
Thom, Victor	§	Euclid Glass.
Thornburg, Clarence W.	Private	Niles Glass.
Thornton, Lloyd M.	Ensign (N)	Providence Base Works.
Thurber, Harry	§	Rhode Island Glass.
Titus, William R.	Private	Ohio Division.
Townsend, Hollis L.	Master Signal Electrician	Nela Operating.
Tragresser, Joseph C.	Private	Niles Glass.
Trimble, William L.	Private	Ohio Division.
Trisko, George F.	Private	Minnesota Mazda Lamp.
Trittipo, Walter E.	Major	Ivanhoe-Regent Works.
*Trotter, James	§ (N)	Oakland Mazda Lamp.
Tucker, Edward J.	Seaman (N)	Rhode Island Glass.
Turner, John J.	2nd Lieutenant	Statistical.
Vanderwerf, Howard W.	Ensign (N)	Engineering.
Vanness, Joseph L.	Private	Euclid Glass.
Van Sickler, Donald	§Private	Oakland Mazda Lamp.
Varnam, Joseph E.		Cleveland Wire.
*Vaughan, David	§	Cleveland Wire.
Vernon, Vinton B	Apprentice Seaman (N)	Engineering.
Vililo, Patrick	Private	Nela Operating.
Vise, Joseph A	Cook	Euclid Glass.
Voccola, Ernest	§	Providence Base Works.
Von Bank, Ray J	Private	Minnesota Mazda Lamp.
Wagner, Charles	§	Euclid Glass.
Walker, Carl C.	Private, 1st Class	Engineering.
*Wallace, Dallas	§	Nela Operating.
Wallace, William A.	Sergeant	Sunbeam Lamp (Chicago).
Walsh, John A.	2nd Lieutenant	Equipment Development.
Walsh, John M.	Private	Niles Glass.
Walsh, William R.	Private	Euclid Glass.
Walters, Robert J	Sergeant, 1st Class	Euclid Glass.
Wanamaker, Eugene	Radio Operator (N)	Ohio Division.
Warren, Walter L.	Private, 1st Class	Engineering.
Weaver, Alfred J.	§	Returned Lamp Inspection.
Webb, H. Leslie	Sapper (Canadian Army)	Nela Lamp.
Weeks, Walter H.	Mechanical Engineer	Bryan-Marsh (Central Falls).
Weir, Thomas L.	Corporal	Nela Operating.
Welton, Joseph A.	Private	Glass Technology.
Wennerstrom, Albert E.	Production Work	Administration.
Wentworth, Percy	§	Providence Base Works.

NAME	RANK WHEN DISCHARGED	DEPARTMENT OR DIVISION BEFORE ENTERING SERVICE.
*Wentz, Frank	§	Niles Glass.
*Whipple, Howard	§	Cleveland Wire.
White, Arthur J	Private	Youngstown Mazda Lamp.
†Whiteman, Harmon E		Niles Glass.
Whiting, Bradford	Private, 1st Class	Returned Lamp Inspection.
†Wilcox, W. A		Euclid Glass.
*Wilkinson, Paul	§	Nela Operating.
Williams, Frank C	Corporal	Youngstown Mazda Lamp.
Williams, John	§ (N)	Niles Glass.
Williams, Robert J	Private	Niles Glass.
Wilson, James H	Private	Nela Lamp.
Windenberg, Earle L	§Aerial Photograph'r	Cleveland Wire.
Wirth, Roy T	Lieutenant (N)	Filament Laboratory.
Wishon, Frank J	Private, 1st Class	Nela Operating.
Wolfe, Harry		Cleveland Wire.
Wolfford, Luke P	Major	Cleveland Carbon Lamp.
Wood, Douglas M	Major	Bryan-Marsh (Chicago).
Wood, Joseph	§	Rhode Island Glass.
*Woodman, Courtney		Puritan Refilled Lamp.
Woods, Wallace W	§	Rhode Island Glass.
Worley, L. P	§Private, 1st Class	Loudon Glass.
Wright, Donald B	Sergeant	Nela Lamp.
Yoakam, Wilbert		Ohio Division.
*Youngblood, J. C	§ (N)	Cleveland Wire.
Zeisler, Jake	§	45th St. Properties.
Zeller, Raymond H	Seaman, 2nd Class (N)	Ivanhoe-Regent Works.
Ziegler, Gus		Niles Glass.
Ziegler, John H	Private	Niles Glass.

PART II

WAR ENGINEERING, DEVELOPMENT AND RESEARCH

How the Men and Facilities of the General Laboratories
of the National Lamp Works Contributed
Towards Making America's
Fighting Machine
Effective

WAR ENGINEERING, DEVELOPMENT AND RESEARCH

THE STORY IN BRIEF

When the United States declared war against militaristic Germany on April 17, 1917, she immediately found herself in a state of such unpreparedness as to dishearten even the most optimistic of all the millions of Americans who so quickly rose in defense of her ideals. From the military point of view, the conditions were appalling. None of the allied countries had entered the war so woefully unprepared as we. With practically no standing army, with practically none of all the vast quantities of guns and ammunition so necessary in modern warfare, with airplanes so few in number as to be the laughing-stock of European countries, with many battleships in our naval fleets long superseded in tonnage and in range of guns by the battleships of foreign powers, and with practically no submarine force at all, it was not surprising that Americans began to question the ability of this country to acquit herself in a manner in any way comparable with her achievements in the past.

It was "up to the United States," and the manner in which she attacked the problems and came through to victory with flying colors is now a matter of history. The preparations made between the time that war was declared and the signing of the armistice, even when viewed in the perspective which the lapse of time affords, were so stupendous as to defy comprehension. And the great force, or the great combination of forces and resources which made this enormous program possible, was *the industrial army of the United States*, numbering more than 38,000,000 well-generaled and well-organized men and women.

The outstanding feature of the entire program undertaken by this industrial army was the quickness with which large organizations, efficiently handled, were able to adapt their immense resources and trained personnel to the war needs of the government. All companies perhaps, large and small, were alike patriotic and alike desirous of serving their country to the best of their ability, but the results produced by large companies which had vast capital and thousands of skilled men and women working in unison for the same general purpose, by organizations which were able to go ahead with investigational and research work for the government without waiting for the usual appropriations, and by enormous plants which had long been using certain processes very similar to the processes demanded by the government in the rush and strain of the war—these results were phenomenal and far outran the original programs.

One of the large organizations which was among the earliest to offer its resources and trained personnel to the government for war work was the National Lamp Works of General Electric Company. All of this organization's corps of experts, engineers and scientists, were offered to the government for any kind of work which the latter might suggest; special equipment and special processes which might possibly result in any saving of time or money were donated as a part of the National's war contributions; and, more especially, all of the advantages to be derived from perfected organization and co-ordination of effort were immediately put at the government's disposal.

Although primarily a lamp manufacturing concern, the National Lamp Works through its General Laboratories in Cleveland, undertook and brought to a successful conclusion an enormous amount of experimental and development work on such a variety of problems as would seem impossible to anyone not familiar with the adaptability and resourcefulness of a large staff of highly trained specialists.

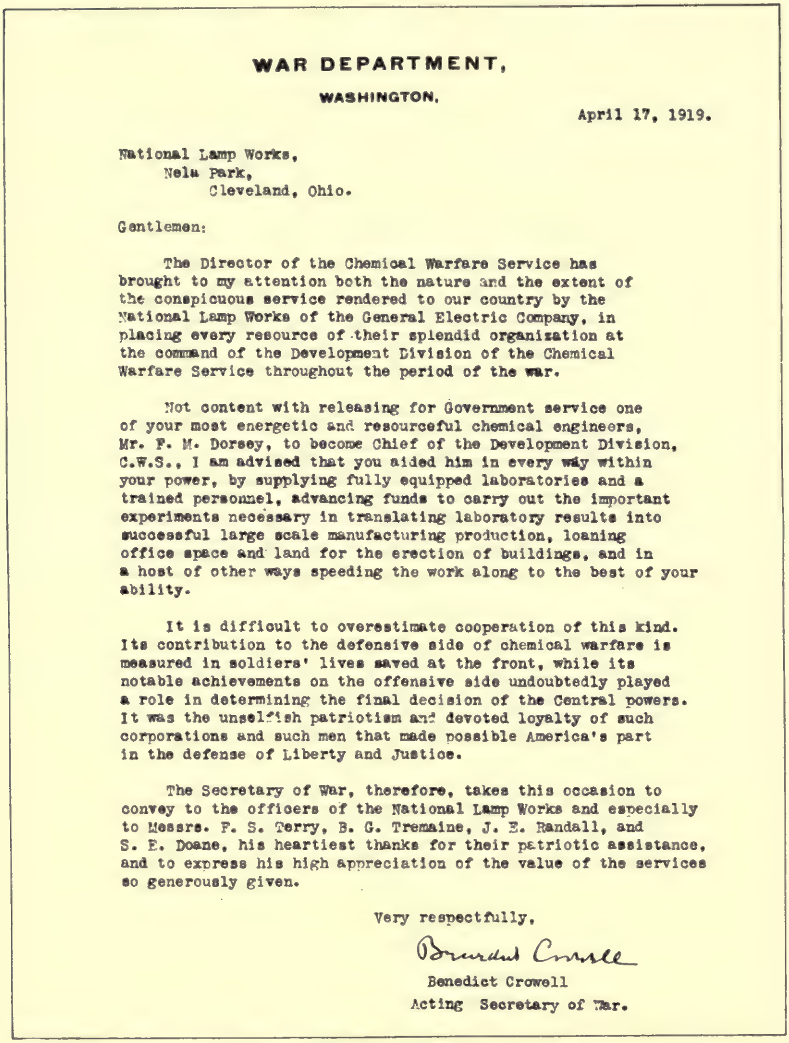
In one of the Nela Park Laboratories exhaustive experiments on carbon were undertaken, the results of which led to the production of the most efficient gas mask introduced overseas. Extensive laboratory investigations were also made on toxic gases, especially mustard gas, and were directly responsible for the early commercial production of these gases. When the armistice was signed, a new gas, the most deadly ever known, was ready to be put on a production basis, prior to its shipment to the Western front.

The only branch of the war work which closely approximated that usually done at the National Lamp Works was the work on vacuum tubes and X-Ray tubes. While not previously familiar with many of the intricate operations required to produce these highly complicated tubes, the personnel of both the Vacuum Tube Division and the X-Ray Tube Division proceeded to apply their own expert lamp manufacturing experience and produced tubes by the thousands of a quality, uniformity, and efficiency that had never before been reached.

Nela Research Laboratory conducted extensive tests regarding the relative advantages of monocular and binocular field glasses. A signalling unit, employing a ribbon filament lamp, was also developed and proved to be decidedly superior to the older types of signalling apparatus adopted by the U. S. Army. The results of the work on airplane camouflage were exceptionally interesting because they represented pioneer work in an absolutely new field of investigation.

Numerous war activities and investigations of a more or less miscellaneous nature were conducted by the Engineering Department of the National Lamp Works, chief among them being the work on the lighting of aviation fields for night flying, landing lights for airplanes, protective lighting for industrial plants, and many different types of indicator lamps. Probably the largest contribution of the Engineering Department was in man-power, the Department being practically stripped of men during the entire war.

The Chemical Laboratory and the Glass Technology Department also conducted valuable research work for the government. A detailed record of all these war activities is given in the following pages.



WAR DEPARTMENT,

WASHINGTON.

April 17, 1919.

National Lamp Works,
Nela Park,
Cleveland, Ohio.

Gentlemen:

The Director of the Chemical Warfare Service has brought to my attention both the nature and the extent of the conspicuous service rendered to our country by the National Lamp Works of the General Electric Company, in placing every resource of their splendid organization at the command of the Development Division of the Chemical Warfare Service throughout the period of the war.

Not content with releasing for Government service one of your most energetic and resourceful chemical engineers, Mr. F. M. Dorsey, to become Chief of the Development Division, C.W.S., I am advised that you aided him in every way within your power, by supplying fully equipped laboratories and a trained personnel, advancing funds to carry out the important experiments necessary in translating laboratory results into successful large scale manufacturing production, loaning office space and land for the erection of buildings, and in a host of other ways speeding the work along to the best of your ability.

It is difficult to overestimate cooperation of this kind. Its contribution to the defensive side of chemical warfare is measured in soldiers' lives saved at the front, while its notable achievements on the offensive side undoubtedly played a role in determining the final decision of the Central powers. It was the unselfish patriotism and devoted loyalty of such corporations and such men that made possible America's part in the defense of Liberty and Justice.

The Secretary of War, therefore, takes this occasion to convey to the officers of the National Lamp Works and especially to Messrs. F. S. Terry, B. G. Tremaine, J. E. Randall, and S. E. Doane, his heartiest thanks for their patriotic assistance, and to express his high appreciation of the value of the services so generously given.

Very respectfully,

Benedict Crowell

Benedict Crowell
Acting Secretary of War.

An appreciation from the Secretary of War of the part played by the National Lamp Works in the achievements of the Development Division, Chemical Warfare Service.

THE STORY OF THE CHEMICAL WARFARE SERVICE

When the United States entered the war against Germany, in April, 1917, there was, perhaps, no phase of the stupendous undertaking that demanded swifter attention than did the problem of combating the use of poison gases, which had been developed by the Germans. And in order that the reader may better appreciate the great importance of the experimental work fostered by the National Lamp Works, in bringing about a satisfactory solution of this problem, we give the following brief resume of the introduction of poison gases in warfare.

The first authentic records we have of the use of suffocating gases in warfare, indicate that about 431 Before Christ, sulphur fumes were used in besieging many cities during the war between the Spartans and Athenians. Centuries later, in August, 1855, in an attempt to reduce Sebastopol, the British Admiral Dundonald recommended the use of sulphur fumes and even worked out the details of the problems attendant with their use. *The English government, however, refused to sanction the proposition on the grounds that no honorable combatant would be willing to inflict the horrible effects that the sulphur fumes had.*

It is quite evident that the probable future use of some form of a poisonous gas was still in the minds of military men when the Hague Peace Conference convened in 1899 for, at this time, many of the prominent European and Asiatic nations pledged themselves not to employ in any form whatsoever, suffocating or poisonous gases in warfare. Among the nations who so pledged themselves was Germany, who ratified this resolution on September 4, 1900. The anti-gas declaration was again considered, and again ratified, at the Second Hague Conference, in 1907. A peculiar circumstance attending both of these conferences was the fact that the United States never signed the resolution.

On April 22, 1915, the Germans broke their solemn agreement and delivered their first gas attack against the Canadians at Ypres. The agonizing effects of this attack are well known. The practical annihilation of the troops who were exposed to the deadly effects of the wicked green chlorine gas, and the utter lack of any accurate knowledge of the means of combating it, will always stand as historic evidence of the treachery and ruthlessness of militaristic Germany in the Great War.

Only those who have seen men badly gassed can realize the horror that accompanied this first attack. Thousands of those in the midst of the cloud were suffocated. Those on the fringe of the cloud saved themselves from the pungent stifling fumes by burying their faces in the earth, or by wrapping mufflers around their mouths and noses. All manner of expedients were resorted to, from handkerchiefs and socks filled with earth moistened with urine, to anything else that could be thought of.

The women of England and France were appealed to, and provided the soldiers with respirators in the form of veils enclosing a handful of cotton wool, which was to be dipped in a solution of sodium thiosulphate (hypo), sodium carbonate and glycerine immediately before using. Within three days about 1,000,000 such respirators were made in England. In the case of one British army, a new respirator was devised and the women in the town immediately behind the front were requested to make a supply. Material was rushed from Paris by every car available and within a few days those French women had provided 80,000 of the new respirators for use in the line of battle. The original veils were reasonably effective against chlorine, but were difficult to operate in the trenches owing to the need of keeping the soaking fluid everywhere convenient. An improvement became imperative as soon as the Germans began to use new and more powerful gases.

Deadly Effects of Gas on Huns Themselves

Whether the German high command had underestimated the probable effect of this first attack and had made no plans for the use of the gas over a more extensive front, or whether they did not realize the actual weakness of the Canadian line, is not known. The fact remains, however, that they did not press their advantage and, with reinforcements rushed up, the immediate danger was over. Strangely enough, too, although the Germans were the first to use poison gas, they were not prepared to defend themselves against it when it was hurled back at them. Their masks were extremely inefficient, and in no way comparable to the masks developed within a very short time by the allies.

How many months, or years, the Germans had been planning for this first gas attack is a mere matter of conjecture. It was probably a pre-war idea, but why a project of such enormous possibilities was not developed to a really practical basis during the years of planning and anticipation is unknown. The utter lack of any preparation by the Germans for meeting a similar emergency in the form of a gas attack launched by the allies would suggest that the German Staff thought that the mere use of the gas would be decisive, or else that the war would be over before the allies had time to strike back with the same weapon.

The necessary arrangements for the launching of a gas attack were quite complex. The gas had, first of all, to be highly poisonous; it had to be available in large quantities; it had to be in such a form as to be easily transportable; and it had to be of such a density as to keep close to the ground when liberated.

Effect of Prevailing Winds

With such a gas on hand, the first serious problem to be considered was the choice of country and, in general, a flat country was preferred. Since the gas would go with the wind, care had to be taken that the attack was not launched in a strong wind which would either disperse the gas cloud or blow it over the enemy trenches too rapidly. Too gentle a wind was dangerous because of the suddenness with which this type of wind changes direction, and it would be disastrous for a gas cloud to be blown back to the trenches whence it came. Natural conditions of the country favored the allies in this respect, since about three-quarters of the prevailing winds were usually blowing away from them toward the German lines.

In connection with this initial gas attack, it is interesting to note that whenever any such act of extraordinary vileness was perpetrated by the German military staff, it was accompanied by considerable exonerating propaganda with the evident purpose of preparing both the home conscience, as well as that of neutral countries, for the proposed innovation. Thus an official German communication was issued, stating that gas warfare originated with the English Admiral Dundonald, whom we have previously mentioned. Again, before the Germans made their first attack (April 1915), charges were made in a similar official communication, that the English were using poison gas against German soldiers, claiming this had been done as early as March 1, 1915. The first British gas attack actually did take place in September, 1915 and not before.

Since Germany had chosen to employ poisonous gases in warfare, self-preservation made it immediately necessary for the allied nations to adopt similar tactics. Accordingly England and France, with feverish haste turned their attention not only to devising methods of protection for their own troops, but also to developing large-scale methods of manufacturing toxic gases to be used against the German army. A German chemist originated most of the new and more powerful forms of gases, but the Teutons were totally unable to produce them on the large-scale basis of production that was rapidly attained both in the allied nations and in America.

NATIONAL LAMP WORKS ENTERS THE FIELD

Hence, it was with a very definite purpose in mind that, early in 1917, various scientific and industrial societies in this country instituted an elaborate census of the facilities and personnel available that might be of assistance in this work. One of the many companies to answer the questionnaires sent out was the National Lamp Works, and one of the many men to reply was Mr. Frank M. Dorsey, Chemical Engineer of the Lamp Development Laboratory at Nela Park.

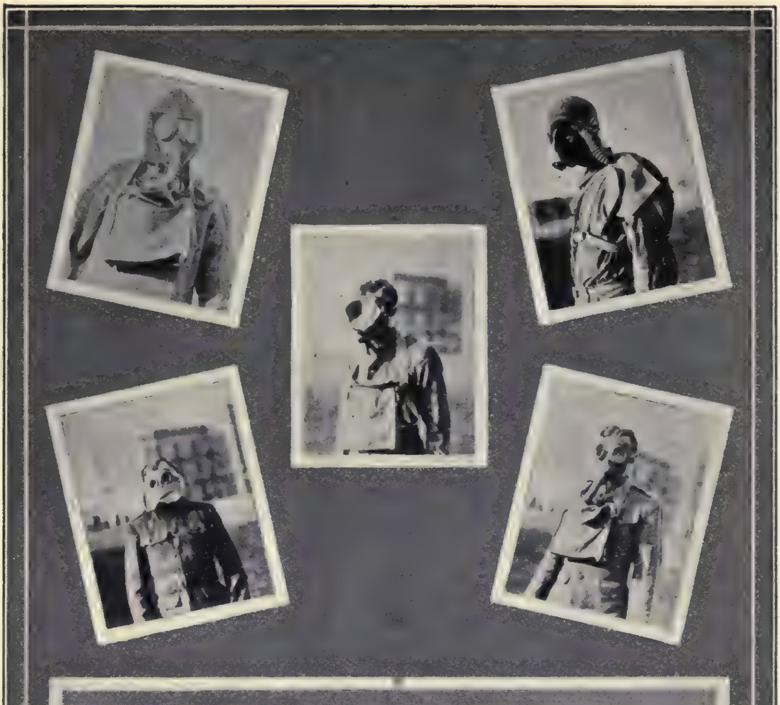
The problems of gas warfare had been detailed by the army and navy of this country to the Bureau of Mines, and Dr. W. K. Lewis was appointed Assistant in Charge of Defense Problems, War Gas Investigations. Accordingly, after an investigation of Mr. Dorsey's questionnaire, Dr. Lewis appeared in Cleveland on April 28, 1917 to enlist the aid of the National Lamp Works and the National Carbon Company in developing an absorbent material for use in gas masks capable of protecting the American soldier.

The first order for gas masks was issued on May 16, 1917, when delivery on 1,100,000 masks was requested before June 30, 1918. At the same time, an immediate request came for 25,000 masks for General Pershing's First Division, who were to sail for overseas within three weeks' time. To produce such

Mr. J. E. Randall
Consulting Engineer of the Lamp
Development Laboratory
National Lamp Works

Major-General W. D. Sibert
Director
of the Chemical Warfare
Service

Colonel Frank M. Dorsey
Chief of Development Division
Chemical Warfare Service



Upper Photos—Different types of gas masks at various stages of development.

Lower Photo—Picture of gas in use in France. The photo clearly shows the density of the gas cloud and its tendency to cling to the depression in the ground.

an order within this time meant to compress England's two years' experience into twenty-one days. Consequently, on May 21, 1917 the making of these first 25,000 masks was started with frantic haste. The processes of manufacture and the number of parts involved called upon the immediate service of various industrial plants. The spirit of co-operation, and a desire to serve the Government, were evident among all the manufacturers from the start, and all available facilities were put into operation.

The situation was indeed a critical one. The American soldier was soon to appear on the battlefields of France. These battlefields were being swept by German gas in ever-increasing quantities, and as yet no satisfactory canister material for gas masks had been developed by any of the allies. Circumstances demanded immediate action. Fortunately, the Government omitted the too-frequent step of "appointing a committee to investigate" and, as a result, Dr. Lewis had come to the National Lamp Works the day after he received his appointment from the Bureau of Mines.

WHAT A GAS MASK IS

The fundamental principle underlying the common type of gas mask is probably well known to all. The air to be breathed by the soldier is drawn through a small tin box or "canister"; thence, by a hose connection, into the face-piece,—an air-tight rubber compartment that fits tightly around the face of the wearer and is provided with suitable glass eye-pieces. The exhaled air passes out of the face-piece through an ingeniously constructed rubber valve. *The tin box had to be filled with some material that would remove the poison-gas from the air as the air passed through the box on its way to the lungs of the soldier.* Obviously, a perfect mask is one which will completely remove every trace of the poisonous fumes from the air, while it is passing through the tin box and before it can reach the eyes, nose or throat of the wearer. The part of the "mask" which filters out the poison is really not the mask proper, or face-piece, at all, but it is the stuff contained in the little tin box.

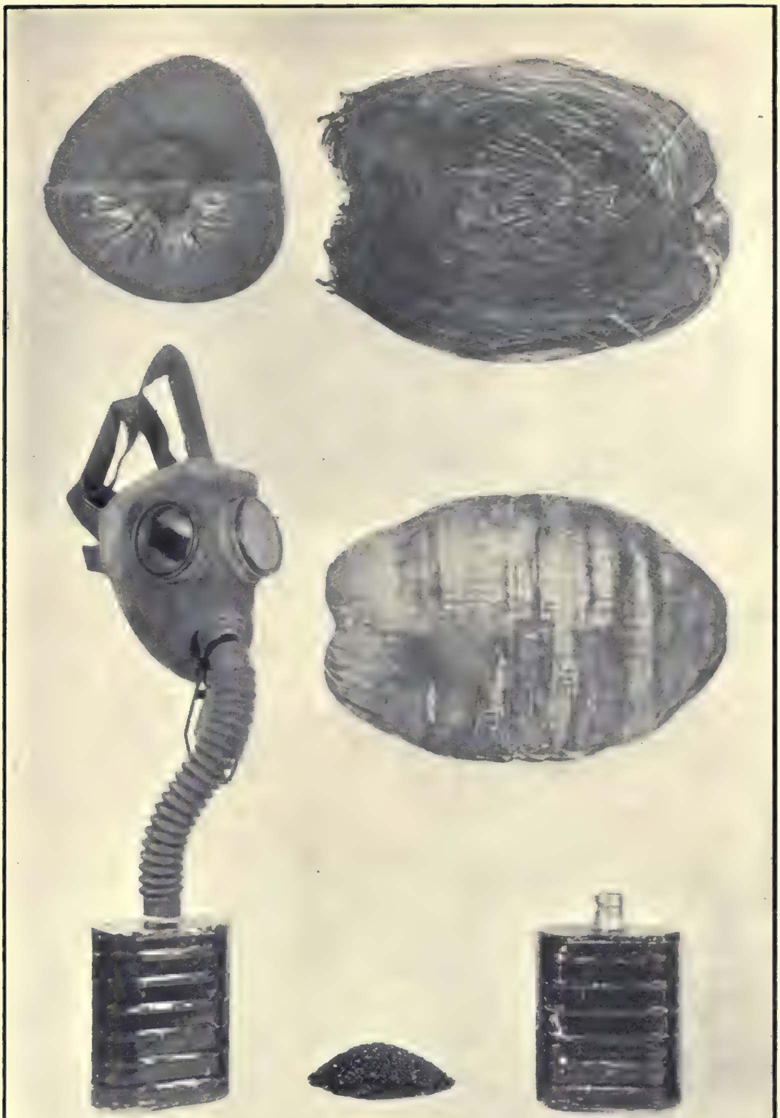
The story of the charcoal which was used in the tin box or canister of the American gas mask is one of the most interesting phases of the entire undertaking. Various canister materials had been tried by the different allies, with results which were far from satisfactory. However, different forms of charcoal, as used by the Russians, had given the greatest degree of protection. Scientists had long been vaguely aware of the general properties of charcoal as a good absorbent for gases, and, consequently, the decision was made in this country to develop a form of charcoal that would be a sufficiently active absorbent to serve as a canister filler. The National Carbon Company knew as much about charcoal as any other concern in the United States and, together with the National Lamp Works, were best prepared to undertake the development of a satisfactory absorbent. Mr. Dorsey had had considerable experience in wood distillation and was chosen by the Bureau of Mines as one of the men to help tackle the problem.

The two Cleveland companies first began independent investigations, but later pooled their energies, maintaining a close spirit of co-operation throughout the entire work. By midnight of April 28, an entire research laboratory at the plant of the National Carbon Company, under the direction of Mr. H. D. Batchelor and Dr. N. K. Chaney, were busy carbonizing woods.

THE START OF THE WORK AT NELA PARK

The National Lamp Works went at it with equal energy. Mr. J. E. Randall, Consulting Engineer of the Lamp Development Laboratory, patriotically agreed to release Mr. Dorsey for this work, and an entire laboratory together with the services of four of the Lamp Development men—Messrs. Hughes, Ibele, King and Cathers—was turned over to Mr. Dorsey for this investigation. In addition, the company agreed to meet all expenses involved, stating that such would be a part of their contribution toward the winning of the war. A special appropriation was made by authority of Messrs. Terry and Tremaine, Managers of the National Lamp Works, for this work. It should be noted that this arrangement, with respect to the Gas Defense Investigation at Nela Park, continued up until February 1919, when the work was ordered discontinued.

Mr. Dorsey and his assistants started work immediately. It is safe to say that the hours observed by these men would have been the cause of grave concern for any union. The results



The three photographs at the top show the cocoanut (with and without the husk), from which much of the charcoal for gas masks was made.

The lower picture is the Tissot Gas Mask with the charcoal used and the canister. The Tissot mask was the latest type developed and was considered by many to be the best type.

Airplane View of Carbon Plant of Defense Section, Development Division, at Astoria, Long Island

The Defense Station of the Gas Defense Detachment, Nela Park of the work at Nela Park, however, together with the results secured at other plants where similar investigations were being carried on, soon served to materially alleviate the situation. By the middle of August, 1917, Mr. Dorsey was assisting in the installation at Astoria, Long Island, of a large-scale production equipment for the manufacture of a form of charcoal which would be most satisfactory as a canister filler. Assistance was also rendered in the initial operation of this plant, the first drum of activated charcoal being shipped September 24, 1917.

It will be remembered that the Nela organization was not the only organization engaged upon the charcoal development problem. The policy the Bureau of Mines had originally adopted was to start investigations independently at a number of places. The most successful process evolved, either through the individual or combined efforts of the different organizations working on the problem, was to be adopted by the Government. The first procedure installed at Astoria represented the combined efforts of both the National Lamp Works and the National Carbon Company. In fact, the entire development of activated charcoal as a canister filler was largely due to the work of these two organizations. This was a rare example of two rival organizations working harmoniously together on the same problem, the work being so arranged as to avoid all unnecessary duplication.

OBTAINING THE BEST GRADE OF CHARCOAL

To most of our readers, no doubt, "charcoal is charcoal," just as "pigs is pigs," but, as a matter of fact, there are as many different kinds of charcoal as there are woods from which the charcoal is derived. And there are also many varied methods of preparing charcoal from any particular wood. All of these factors affect the absorptive qualities of the charcoal for gases. Any charcoal will absorb a definite percentage of its weight of gas. Hence, the densest charcoals will be most efficient, weight for weight, in a given space. The dense material immediately surrounding the meat of the cocoanut, commonly called the cocoanut hull, was found to be the most compact form in which carbon exists in nature in commercial quantities, and was capable of giving the best, or most porous form of charcoal.

The most efficient procedure for carbonizing cocoanut hulls was next evolved, but while it was found that the charcoal so produced was a very effective absorbent for chlorine, it was not sufficiently absorbent for chlorpicrin or phosgene to be used as a canister filler. During the process of carbonization, numerous impurities had condensed in the pores of the material and had prevented maximum contact between the carbon and the gas, retarding the rate of gas absorption. Consequently, it became necessary to devise some method of removing these impurities or, as the process is generally known, of "activating" the charcoal.

The first procedure installed at Astoria involved the production of charcoal from cocoanut hulls, and the removal of the impurities by a process of burning. The later "activation" process consisted in giving the charcoal a second highly specialized heat treatment which gave it a greatly increased absorptive power.

FORMATION OF DEFENSE SECTION, DEVELOPMENT DIVISION, CHEMICAL WARFARE SERVICE

At this point, however, the investigation did not cease but, on the contrary, expanded rapidly. Major Bradley Dewey, then officer in charge of Gas Defense Service, asked that work in connection with this and related problems be continued both at the National Lamp Works and the National Carbon Company. He agreed to furnish Mr. Dorsey with the required number of chemists and engineers for carrying on the new development work and on November 11th, 1917, 30 soldiers were sent to Nela Park to assist the overworked organization there.

The soldiers, of course, received their pay checks from the Government, but the National Lamp Works continued to provide laboratory space, equipment and supplies for carrying on the work. Everything was done to make the work of the men as pleasant as was consistent with the strenuous duties in which they were engaged. Frequently, in the year 1918, bebetween 150 and 250 soldiers were quartered at Nela Park. Through the efforts of the Service Department of the National Lamp Works all the recreation facilities that could be given them were thrown open, and they made good use of the tennis courts, the baseball field, bowling alleys, etc. In baseball they had their own team in the Service Department's Twilight League, incidentally winning the championship.

The Operating Department furnished laborers, carpenters and plumbers to the detachment so as not to delay the work which was being carried on. They also gave the detachment first call on all automobiles and trucks for transporting material until the necessary equipment was obtained. The manager of the Operating Department, Mr. P. C. Lynch, aided the men at different times to find suitable rooms when the detachment was not able to take care of them.

Mrs. Lynch placed as high as 125 boys every Sunday during the influenza epidemic, sometimes for both lunch and dinner. This saved the boys a trip down town, as the restaurants around Nela Park were seldom open on Sundays.

The detachment grew as the work expanded. In August, 1918, with the authorization of the Chemical Warfare Service and the formation of the Development Division of this service with Colonel Dorsey as Chief, the Nela Park Defense Detachment became the Defense Section of the Development Division, where, at the time of the armistice, 250 officers and men were engaged on gas defense problems. From April 28, 1917, when the problem was first under consideration, until the signing of the armistice, Cleveland was the center for the development work on "activated" charcoal, the material which helped to make the American gas mask the best on foreign battlefields.

Mustard Gas Comes to the Front

The old axiom that "history repeats itself" was strikingly demonstrated at Ypres on July 20, 1917, when the Germans introduced "mustard gas" (so-called on account of its odor, and not because ordinary mustard has anything to do with its manufacture) in an attack covering practically the same point in their salient as did the original gas attack two years before. Shortly afterwards, similar bombardments with this material were made at Nieuport and Armentieres. During a period of ten days, the Germans used about one million gas shells, corresponding to approximately 2,500 tons of this powerful toxic compound. The use of "mustard" thereafter became general and it was immediately realized that for certain purposes of fighting this chemical was the most effective product so far employed; in fact, it was considered such an effective weapon that it was immediately termed "The King of War Gases." The tactical advantage of this poison gas lies, not in its immediate killing power, but in its persistence and the great sensitiveness of the eyes, lungs and skin of men exposed to small concentrations of this material in the atmosphere.

A large number of Government experts at once concentrated their energies on developing large-scale methods of manufacture, and the production of mustard gas in huge quantities became one of the principal objectives of those in charge of gas warfare problems. Nobody in any of the allied countries or in America had ever produced the gas in commercial quantities and, upon examination, the clumsy, expensive methods used by the Germans proved to be totally inadequate for extensive production. No definite manufacturing procedure had been submitted to the U. S. Ordnance Department, and Colonel Walker, Commanding Officer of the Gunpowder Reservation, at Edgewood, Maryland, later known as Edgewood Arsenal, where it was proposed to manufacture "mustard," suggested through Dr. Lewis that development work be started immediately by Mr. Dorsey in Cleveland.

The National Lamp Works had permitted Mr. Dorsey to give his entire time to war work, and he readily agreed to take over the new problem. The National agreed to meet all expenses involved in the new development, reïmbursement to be made at the convenience of the War Department. By this arrangement, it was possible to avoid the initial delay for securing the proper appropriations from the Government.

Preliminary information was received from the American University at Washington, D. C., on the basis of which a small experimental plant was established March 12, 1918 in Cleveland, at East 131st Street and Taft Avenue, for the purpose of further developing this process for large-scale manufacture. This station was originally established as a branch of the Edgewood Arsenal, and Mr. Dorsey was appointed technical director. This arrangement continued until August, 1918, when, with the authorization of the Chemical Warfare Service, the East 131st Street station became the Offense Section of the Development Division, Chemical Warfare Service, with Colonel Dorsey as Chief. The function of this Division, as authorized, was to take processes for the manufacture of war-gas material as worked out on a laboratory scale by the Research Division (located at the American University) and develop these processes to a large-scale production basis.

No time was lost in putting the Cleveland plant in shape for experimental work and from April 2nd, 1918, when the first run was made on the new installation, until the signing

Plant used by the Offense Section, Development Division, at E. 131st Street and Taft Ave., Cleveland

Another View of the Offense Station, indicating the Size of the Plant

Airplane View of Mustard Gas Plant at Edgewood Arsenal, Maryland

Maj. L. J. Willien　Mr. Henry L. Doherty (of H. L. Doherty & Co.)　Lt.-Col. W. G. Wilcox

Capt. Dale C. Hughes　Capt. J. R. Duff　Capt. Duncan MacRae

Capt. C. S. Venable　Capt. W. H. MacAdams　Capt. O. L. Barnebey

Miss T. A. Dromont　Mr. P. B. Test

of the armistice, this plant was the development center for "mustard." Within a short time, the original personnel of 35 men was increased to 175 officers and enlisted men. No barracks or mess halls were provided, the men being permitted to make their own arrangements in this respect. The majority found rooms in the immediate vicinity and patronized the numerous restaurants within easy walking distance of the plant.

COLONEL DORSEY ORGANIZES "MUSTARD" DEVELOPMENT WORK

The men did their work well. Most of them actually seemed to enjoy it. On the day that each man reported, he was informed of the nature of the problem before him and of its tremendous importance. Consequently, they performed willingly all of the hazardous and tedious duties required of them. The men had but one ambition—they were determined to "put mustard across."

In general, while no attempt was made at this plant to produce mustard in quantities beyond that required for experimental purposes, the results obtained were immediately submitted to the Edgewood Arsenal, the Hastings-on-Hudson plant, the National Aniline and Chemical Company plant at Buffalo, and the Dow Chemical Company at Midland, Michigan, where mustard was to be made. In May, Mr. Dorsey was placed in charge of all the large-scale manufacturing development work conducted by the Bureau of Mines. To avoid duplication, all experimental work on mustard save that conducted at the Midland and Cleveland stations, was discontinued. It was originally intended to expand the experimental work at Midland to actual production, but in September, 1918, the work at Midland was ordered discontinued.

On May 1st, Mr. Dorsey was placed in charge of the Manufacturing Development Division of American University. He held this position until August 22, 1918, at which time he was commissioned as Colonel in the Chemical Warfare Service. While in charge of this work, Mr. Dorsey worked not only on "mustard" gas, but also on "tear" gas, "sneeze" gas, and several others of an extremely toxic nature. In addition to the work in Washington, he had charge of the development work at Midland, at Hastings-on-Hudson, the East 131st Street Laboratory, and the Nela Park Laboratory. Mr.

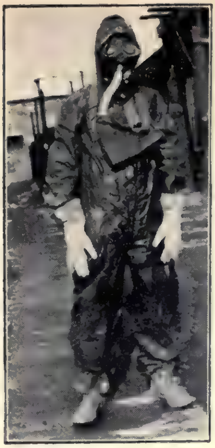
Dorsey also acted as technical advisor for the defense work at Astoria, Long Island.

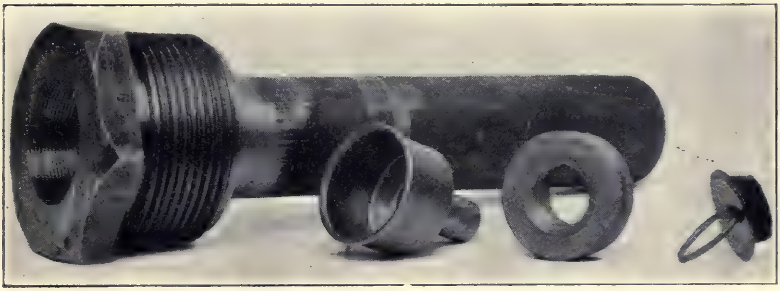
In connection with the production of mustard gas itself, it will probably be of interest to include here a few words with regard to the nature and properties of the compound under consideration. As a matter of fact, "mustard gas" is not a gas at all. When pure, it is a colorless liquid, having a slightly oily appearance. Contact with the liquid itself gives a very serious burn unless the substance is removed by hot water and soap within one minute's time. To breathe for two minutes air saturated with mustard gas at ordinary room temperature would most certainly be fatal. Bare skin exposed to such an atmosphere for two minutes would be badly blistered twelve hours after the exposure. The mustard fumes readily penetrate ordinary clothing. An insidious feature of this particular gas was the fact that its action is practically always delayed. Several hours might elapse after a man was gassed, even fatally, before he became aware of it, and then it was too late to administer the treatment that might save his life. Hence, the utmost precaution had to be observed in handling the material, expecially in large quantities.

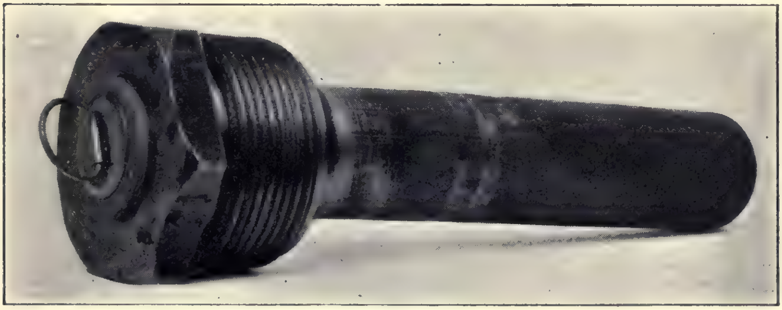
For the mustard production experiments, a part of the plant was partitioned off and a ventilating system so arranged as to create a strong draft around the exposed parts of the apparatus, the air in the whole room being changed once a minute. The "crew" were all equipped with gas masks, oilcloth suits and rubber gloves. The accompanying photographs show some of the protective measures taken by the men handling the mustard.

Mustard Gas Produced in Large Amounts

By June 1, 1918, a complete plant equipment together with a satisfactory operating procedure had been worked out; a large part of the apparatus necessary for large-scale production had been designed, assembled, and shipped to the Edgewood Arsenal, Maryland; and a number of men loaned from the East 131st Street station were assisting in the actual operation of the mustard plant at Edgewood. A number of important developments and modifications were subsequently made in parts of the original procedure recommended for use at Edgewood. In August 1918, for instance, a much superior process, suggested by the British,



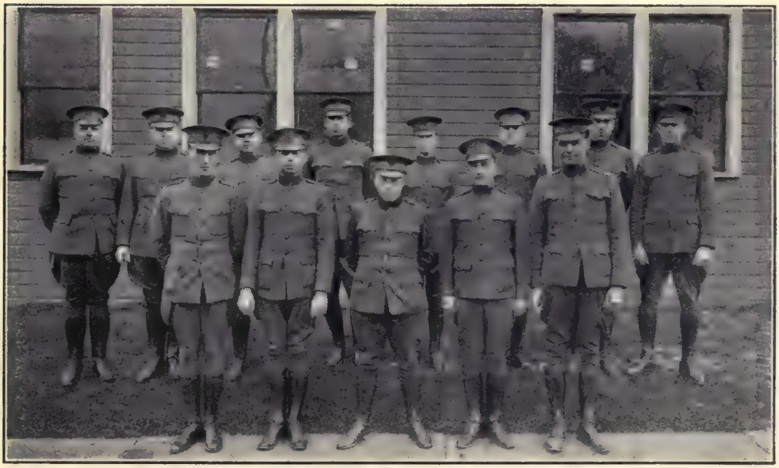




Upper Photo—The Mustard Suit (at the left) shows the care taken to protect the wearer from the effects of contact with the gas.
Upper Photo (right)—Burying Mustard to avoid accident to the men working with it.
Center—Picture of the Booster Casing of a Gas Shell, stripped, to show the different parts.
Lower Photo—The Booster Casing assembled.

Headquarters Building of the Development Division, Nela Park

Private residence, leased by National Lamp Works, used by Purchase, Contract, and Transportation Sections, Development Division.



Officers attached to Headquarters, Development Division.

Top Row—left to right—Lts. Hart, Dobe, Buckley, Hoffman, Westbrook, Fulks, Penfield, Staley.

Bottom row—left to right—Capts. Duff, McAdams, Col. Dorsey, Capts. MacRae, Cover.

was developed at the Cleveland station and later put into operation at the Edgewood plant. The whole mustard manufacturing process was thus gradually developed to such an extent that at the end of October the American plants were turning out more of this material than all the plants of England, France and Germany combined.

It is a simple statement of fact—not a boast—to state that, had the proposed allied drive for the spring of 1919 been found necessary, the quantity of mustard that would have been showered upon the German armies would have made Ypres, July 20, 1917, a painful memory to the German nation for years to come.

From June 1st on, the East 131st Street station was engaged in problems related to mustard gas manufacture, particularly those related to the purification of the product, and to the production of mustard by the new British scheme mentioned above. Development work on two other poison gases was begun, but this work was discontinued by order of the War Department before final development stages were reached. When the end of the war put a stop to all activities at this post, the entire plant was being turned over to the development of a third gas.

With the formation of the Chemical Warfare Service, as already stated, the East 131st Street station became the Offense Section of the Development Division. By August 1st, the financial side of this new branch of the service had become sufficiently well established to make it possible for the National Lamp Works to withdraw from the arrangements by which the Company had been advancing the money necessary to meet the expenditures at the East 131st Street station.

On February 27, 1918, Dr. A. W. Smith, of the Bureau of Mines, established a station at the plant of the Dow Chemical Company at Midland, Michigan, for the purpose of securing raw materials for both mustard and chlorine gas. The Dow Chemical Company is one of the largest plants in the United States manufacturing chemicals only. The brine wells at Midland run unusually high in the percentage content of certain chemicals used in the manufacture of poison gases and, after an investigation conducted by Dr. Smith, plans were laid for the sinking of seventeen brine wells. Work on this project was not begun until March, 1918, but the project was practically completed when the armistice was signed.

The experimental work at Midland was mainly concerned with the design and construction of large-scale apparatus for the production of mustard gas, using procedures evolved on a laboratory scale at other stations. Comparatively little laboratory work itself was done at Midland.

In August, 1918, with the formation of the Chemical Warfare Service, the Midland station became the Midland Section of the Development Division, with Colonel Dorsey of the National Lamp Works as Chief. The actual supervision of the work, however, was maintained by Dr. Smith. By August 20, an entire plant for the production of mustard had been developed and operated successfully with a plant capacity of five tons per day. The original plans were that, should the development work at Midland prove successful, the plant of the Dow Chemical Company should assume actual production on a scale of forty tons per day. This same month, however, the War Department ordered the work discontinued.

It is thus seen that the work performed at the Defense and Offense Sections, in the support of which work the National Lamp Works had taken such an active part, was largely concerned with the development of the most important gas warfare materials produced by the Chemical Warfare Service—namely, activated charcoal by the Defense Section, and mustard gas by the Offense Section. According to the original plan, the work performed at Cleveland was development work, that is, the processes evolved elsewhere on a laboratory scale were developed in Cleveland to a large-scale production basis. The finished apparatus and designs were then turned over to other stations where the actual production was accomplished.

THE MILITARY SITUATION DEMANDED A MORE POWERFUL GAS

In July, 1918, the military situation was by no means all that could be desired. As a result of a series of tremendous drives, the German army had almost accomplished their two-fold object of capturing Paris and, at the same time, of driving a wedge between the French and British armies. These drives had been characterized by a greatly increased use of poison gas by the Germans, especially mustard gas. Though all of the allies used the same forms of gases as the Germans, in every case the use of a new poison gas by the Germans preceded its use by the allies. Consequently, the latter were always at a great disadvantage in this respect, and were always somewhat behind in these "up-to-date" methods of wholesale man-killing.

There was no lack of realization in our own War Department that the German supremacy in the use of poison gas formed a very serious obstacle to the complete success of the plans outlined by the allied general staff. Strenuous efforts were being made, both at Edgewood Arsenal and elsewhere, to make up our deficiencies in this respect by producing those gases, which so far had proved to be most effective against the Germans, on such a scale as would assure to our armies an adequate and constant supply of poison gases of the highest possible quality. At the same time it was hoped that the American chemist would hasten the end of the war and contribute largely to our share in the final victory by producing, in sufficient quantities, *a new poison gas which would be more effective than anything previously used.*

The Research Division of the Chemical Warfare Service at American University, Washington, D. C., had been working for several months on the laboratory development of such a gas, and it is sufficient to say that a new material had been found, an intensely poisonous liquid somewhat similar to mustard gas in its effect on the human system but enormously more effective. It was felt that the introduction of this material into gas warfare, if made at a *critical moment* and as a *complete surprise* to the Germans, might easily prove decisive.

There remained, however, the problem of working out the details of large-scale manufacture of the new gas which will be known herein as the G-34, and the task of producing it in quantity sufficient for use on the Western Front in the spring of 1919. This was the problem assigned to Colonel Dorsey as Chief of the Development Division on July 12, 1918. It was further ordered that this Division was to be on a production basis by December 1, 1918.

Work on the Most Poisonous War-Gas Ever Known

Colonel Dorsey attacked these problems with characteristic vigor and lack of ceremony. On July 12th, he had been notified of the new task assigned to him. By the 26th of the same month a suitable location for the Experimental Plant had been found at Willoughby, Ohio, and was occupied by a guard of twenty-five men from the Offense Laboratory in Cleveland, Lieutenant-Colonel Wilcox in charge, whose splendid work as an executive was responsible for the progress of the organization. An idea of the accomplishments of the men who formed the group stationed at this plant may be obtained only when one considers the many difficulties which were successfully overcome and the many expedients resorted to in order to secure material with the least possible delay. A direct appeal to the mayor of the town resulted in getting all of the contract work completed in the plant in the shortest possible time. The utter lack of transportation service was finally remedied after every possible type of conveyance had been impressed into the work.

By August 12th, the laboratory equipment had been installed and the research work was started under the direction of Major James B. Conant. The progress made in this laboratory research work, under the inspiration of Major Conant's energetic supervision, was truly wonderful, and as a result of the work revolutionary changes were made in some of the processes as originally planned for the manufacture of the G-34.

By November 1, 1918, practically every detail of the plant organization had been provided for. All of the plant lay-outs had been completed; all the equipment had been ordered, and much of it delivered; and in general the work of converting plans and research results into the actualities of large-scale production was nearing completion. By the time the armistice was signed, practically all of the large-scale units for the various steps of the manufacturing procedure were completed, sufficient raw material was on hand to make a good beginning of quantity production, and plans for the large plant were complete, awaiting the approval of the Secretary of War.

THE SPECIAL INVESTIGATIONS SECTION

As the general work of the entire Development Division progressed, need was felt for a separate organization having for its purpose the solution of various problems which constantly came to attention and yet which could not be directly attached to any already existing section. The work which already had been assigned was amply sufficient for each section, and there was an acute need for a new section which would be able to devote its entire attention to the miscellaneous problems demanding immediate investigation. As a result, the Special Investigations Section was formed on August 10, 1918, with Captain Duncan MacRae in charge, and began work at once on the problem of obtaining a satisfactory "booster casing" for the 75-millimeter gas shell.

The "booster casing" derived its name from the fact that it is the container that holds both the boosting explosive charge and the "spark" which is used to ignite the explosive in the shell. Any explosive confined within the walls of a shell requires a certain amount of air and a certain spark to "set it off" properly. The spark obtained from the fuse used in the gas shell is very small and must be greatly increased or "stepped up" in order to cause the explosion of the main charge.

The booster casing itself was a hollow steel or alloy tube, about one inch in diameter and four inches long, fitted with external threads on one end so that it could be screwed into the nose of the gas shell. A powerful explosive, usually "TNT," in such a form that it could be handled easily without danger of unintentional explosion, was packed in the bottom of the tube. Then a small tube or cup of fulminate of mercury was set in and attached to the tube fuse controlling the firing action. The small spark from the fuse explodes the fulminate of mercury which, in turn, sets off the main charge of TNT, rupturing the shell itself and allowing the poison gas to be released.

Various methods of manufacture of the booster casing were investigated, and a number of different materials tried. The conclusion drawn from these investigations was that the best solution of the problem lay in the manufacture of the casings from one piece of steel. An experimental production unit was established at the plant of the U. S. Automatic Company at Amherst, Ohio, capable of producing 2000 booster casings per 24-hour day.

On August 17, 1918, the problem of duplicating the French process of lining gas shells with glass was assigned to the Special Investigations Section. The object of the glass lining in the shell was to prevent the corrosion of the steel casing of the shell which would occur if the gas were in direct contact with the steel. The glass-lined shell was absolutely necessary for the use of Brom-Benzyl Cyanide, the most effective tear-gas known. As early as June 1918, Dr. A. W.

Smith of the Bureau of Mines had asked Mr. W. M. Clark, manager of the Glass Technology Department of the National Lamp Works, for advice and assistance on this problem. On August 6, 1918, Dr. Whitney, who as a member of the Naval Consulting Board was familiar with government needs, telegraphed Mr. Clark to meet him at the Ordnance Department in Washington. At this conference, Mr. Clark was shown a cablegram from General Pershing, dated June 16th, covering the matter of glass-lined shells as used by the French artillery. Immediately following Mr. Clark's return to Cleveland, a series of experiments was begun in Mr. Clark's department at the National Lamp Works, paralleling the work undertaken by the Special Investigations Section.

Some experimental work on the problem had been carried out at the Corning Glass Works, Corning, New York, under the direction of this Section, and it had been concluded that a glass-lined shell, on account of its fragility, was inferior to an enameled or lead-coated shell. The experiments were conducted for the purpose of improving details of manufacture so as to produce a glass lining more capable of withstanding the shock and jar of long transportation and storage. More than 700 shells were lined, and a lining developed that would withstand a drop of fifteen inches on a concrete floor. Out of 125 of these shells which were shipped from Corning to Cleveland, a distance of 311 miles, only two linings cracked. The seal between the booster casing and the glass lining was so arranged that cracking the glass would not result in any leakage of the gas.

Thanks partly to the efforts of Mr. Clark and the other National Lamp Works men who were engaged on this problem, production at the rate of 500 per day could have been attained on a week's notice at the time of the signing of the armistice.

The complete organization of the Development Division is given in the chart on page 187.

CHEMICAL WARFARE SERVICE—PROBLEMS AND METHODS

It is quite obvious from the foregoing discussion of the work fostered and carried on by the National Lamp Works in co-operation with the Chemical Warfare Service, that the entire personnel in charge of the organization consisted of highly trained and highly specialized engineers and scientists. As such, it is obvious that the greater amount of their work was of a character unintelligible to the layman. Consequently, for the sake of these chemists and those who worked with them, many of whom will read these pages, it has been considered best to include a separate account of the actual problems investigated; the methods used to solve those problems; the names of the men engaged in the work; and the final successful accomplishment of the problems turned over to the National Lamp Works for investigation.

Headquarters, Development Division

In May, 1917, when the charcoal development work began at Nela Park, there was not even a definite headquarters office. Room 104 in the Lamp Development Laboratory had been taken over for the experimental work, and Mr. Dorsey shifted his desk around in this room so as to interfere as little as possible with the work at hand. In November, 1917, Room 248 in the same building was given to Mr. Dorsey for an office. Here Mr. Dorsey, with his secretary, Miss T. A. Dromont, kept all the files and records, and transacted all the business details connected with the investigation.

Any reference to the large amount of clerical work which went through the Development Division Headquarters would be incomplete without particular mention being made of the capability and efficiency with which this work was handled by Miss Dromont. Originally connected with the National Lamp Works, Miss Dromont was transferred to the Chemical Warfare Service in June, 1918, continuing her work in this Service until May 1st, 1919. She had complete charge of all secretarial work for Mr. Dorsey, including the handling of correspondence, bookkeeping, filing and technical reports. She also satisfactorily took care of all stenographic work for the entire Headquarters personnel from November 11, 1917, to August 20, 1918, at which time the organization had grown to such proportions as to make it impossible for one person to handle.

At this time the activities of the different experimental stations had increased to such an extent that the technical reports coming into Headquarters for approval threatened to swamp Captain McAdams, who was acting as executive assistant to Mr. Dorsey. Accordingly, on July 15, Lieut. L. R. Westbrook was transferred from the East 131st Street Station to aid in the revising of all outgoing technical reports. A little later a Confidential

Information Section was established for this purpose, with Lieut. Westbrook in charge.

On August 1st, the Development Division was established and Mr. Dorsey was appointed Chief, with the rank of Colonel. On August 10th, Capt. J. R. Duff was appointed Adjutant for the newly formed division and immediately assumed the duty of organizing a General Office. Captain Wright and Lieutenants McCurdy and Fulks were transferred from the East 131st Street Station, and Lieutenant Dobe from the Defense Station. A number of stenographers were secured. For temporary quarters for this office, a room in the Sales Building, Nela Park, previously used as a gymnasium, was secured. Colonel Dorsey, Captain McAdams and Lieutenant Westbrook, however, retained their offices in the Lamp Laboratories Building. At this time also, a Special Investigations Section was formed, with Capt. MacRae in charge. A third adjoining room to the Lamp Development Laboratory Offices was secured for use by the Confidential Information and Special Investigations Sections.

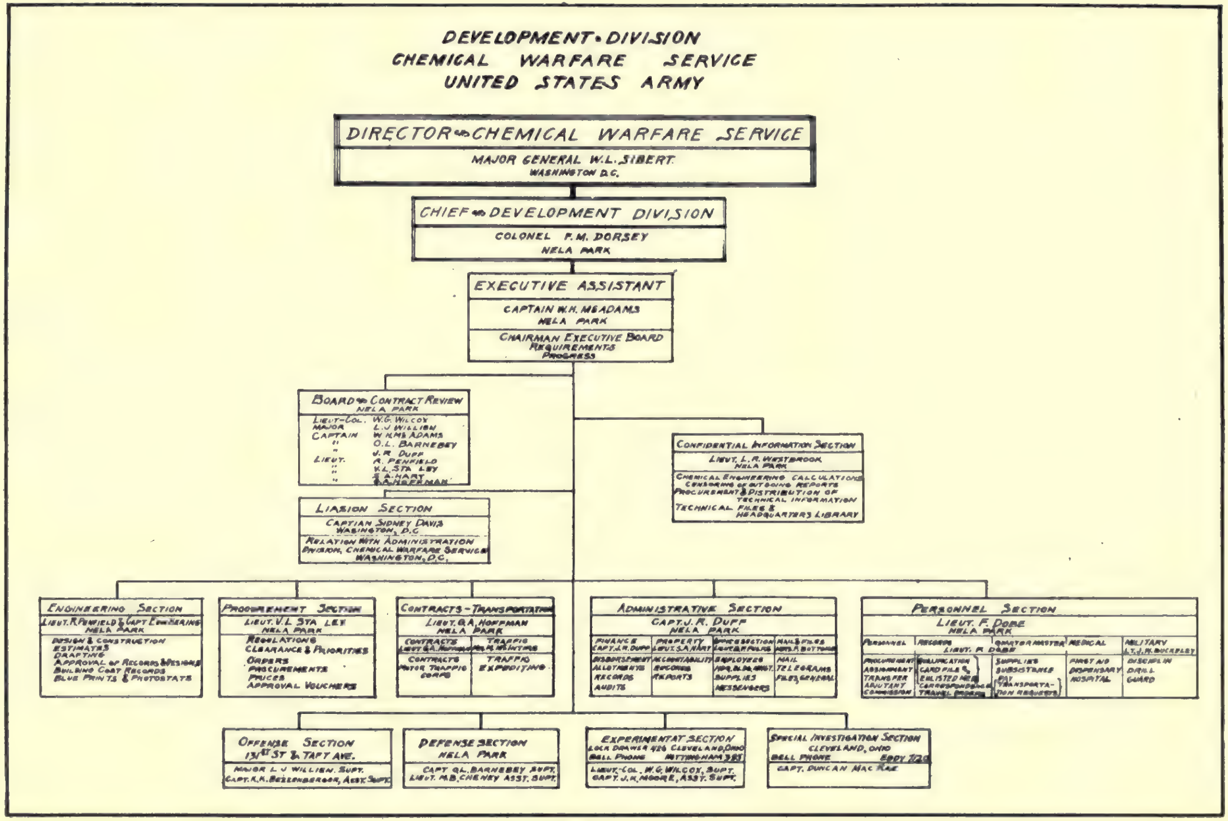
On October 4th a substantial frame structure, shown in the accompanying photograph, was erected on the ground of the National Lamp Works and, with Captain Duff in charge, was used as offices by the Finance Division. Colonel Dorsey, together with the General Office, the Confidential Information Section, and the Special Investigations Section, moved into this building. The Engineering Section, under Lieut. Penfield, was also transferred from the East 131st Street Station to the Headquarters building. This building was more or less crowded, and many changes and transfers were made. November 1st, a house located near the Defense Section building was leased by the National Lamp Works for use by the Purchase, Contract and Transportation Sections, under Lieutenants Hoffman and Staley.

The accompanying chart gives the organization for Headquarters on November 11, 1918. The duties of all the different sections are clearly defined by this chart, with the probable exception of the duties of the Special Investigations, Engineering, and Confidential Information Sections. The work of the Special Investigations Section will be discussed in detail in later pages. It is well at this point to describe somewhat in detail the functions of the Engineering and Confidential Information Sections.

ENGINEERING SECTION

The function of this section had to do with the design and construction of all buildings, apparatus and equipment to be erected at the different stations of the Development Division, with the exception of the Midland station. The work at Midland was taken care of by the Engineers of the Dow Chemical Company. Lieut. Richard Penfield was in charge of the Engineering Section, with Capt. Edward Hering as his assistant. About twenty draftsmen were employed in this section, the names of these men being included in the Headquarters and Personnel lists. (A branch of this section was established at Willoughby to take care of work at that station.)

The duties of this section not only involved the design of buildings and equipment, but also the supervision of the actual construction according to these designs. Too much cannot be said with regard to the success of the Engineering Section in solving the many problems that confronted it.


DEVELOPMENT • DIVISION
CHEMICAL WARFARE SERVICE
UNITED STATES ARMY
DIRECTOR OF CHEMICAL WARFARE SERVICE
MAJOR GENERAL W.L. SIBERT
WASHINGTON D.C.
CHIEF OF DEVELOPMENT DIVISION
COLONEL F.M. DORSEY
NELA PARK
EXECUTIVE ASSISTANT
CAPTAIN W.H. MEADAMS
NELA PARK
CHAIRMAN EXECUTIVE BOARD
REQUIREMENTS
PROGRESS
BOARD OF CONTRACT REVIEW
NELA PARK
LIEUT-COL. W.G. WILCOX
MAJOR L.J. WILLIEN
CAPTAIN WM. MCADAMS
" O.L. BARNEBEY
" J.R. DUFF
LIEUT. R. PENFIELD
" V.L. STA LEY
" S.A. HART
" G.A. HOFFMAN
CONFIDENTIAL INFORMATION SECTION
LIEUT. L.R. WESTBROOK
NELA PARK
CHEMICAL ENGINEERING CALCULATIONS
CENSORING OF OUTGOING REPORTS
PROCUREMENT & DISTRIBUTION OF TECHNICAL INFORMATION
TECHNICAL FILES & HEADQUARTERS LIBRARY
LIASION SECTION
CAPTIAN SIDNEY DAVIS
WASINGTON, D.C.
RELATION WITH ADMINISTRATION DIVISION, CHEMICAL WARFARE SERVICE
WASHINGTON, D.C.
ENGINEERING SECTION
LIEUT. R. PENFIELD & CAPT. E.W. HERING
NELA PARK
DESIGN & CONSTRUCTION
ESTIMATES
DRAFTING
APPROVAL OF RECORDS & DESIGNS
BUILDING COST RECORDS
BLUE PRINTS & PHOTOSTATS
PROCUREMENT SECTION
LIEUT. V.L. STA LEY
NELA PARK
REGULATIONS
CLEARANCE & PRIORITIES
ORDERS
PROCUREMENTS
PRICES
APPROVAL VOUCHERS
CONTRACTS - TRANSPORTATION
LIEUT. G.A. HOFFMAN
NELA PARK
CONTRACTS
LIEUT. G.A. HOFFMAN
TRAFFIC
CONTRACTS
MOTOR TRAFFIC CORPS
TRAFFIC
EXPEDITING
ADMINISTRATIVE SECTION
CAPT. J.R. DUFF
NELA PARK
FINANCE
CAPT. J.R. DUFF
DISBURSEMENT
ALLOTMENTS
RECORDS
AUDITS
PROPERTY
LIEUT. S.A. HART
ACCOUNTABILITY
RECORDS
REPORTS
SERVICE SECTION
EMPLOYEES
SUPPLIES
MESSENGERS
MAIL & FILES
MAIL
TELEGRAMS
FILES, GENERAL
PERSONNEL SECTION
LIEUT. F. DOBE
NELA PARK
PERSONNEL
PROCUREMENT
ASSIGNMENT
TRANSFER
ADJUTANT
COMMISSION
RECORDS
LIEUT. F. DOBE
QUALIFICATION
CARD FILE
ENLISTED MEN
CORRESPONDENCE
TRAVEL ORDERS
QUARTERMASTER
SUPPLIES
SUBSISTENCE
PAY
TRANSPORTATION REQUESTS
MEDICAL
FIRST AID
DISPENSARY
HOSPITAL
MILITARY
DISCIPLIN
DRILL
GUARD
OFFENSE SECTION
131ST ST & TAFT AVE.
MAJOR L.J. WILLIEN, SUPT.
CAPT. K.K. BEZZENBERGER, ASST. SUPT.
DEFENSE SECTION
NELA PARK
CAPT. O.L. BARNEBEY SUPT.
LIEUT. M.B. CHENEY ASST. SUPT.
EXPERIMENTAT SECTION
LOCK DRAWER 426 CLEVELAND, OHIO
BELL PHONE NOTTINGHAM 385
LIEUT.-COL. W.G. WILCOX, SUPT.
CAPT. J.K. MOORE, ASST. SUPT.
SPECIAL INVESTIGATION SECTION
CLEVELAND, OHIO
BELL PHONE EDDY 720
CAPT. DUNCAN MAC RAE

These problems ranged from the design of small pieces of special plant apparatus to a complete plant lay-out such as that at Willoughby.

CONFIDENTIAL INFORMATION SECTION

This section consisted of three men, Lieut. L. R. Westbrook (in charge) and Sgts. Beckett and Hartley. The work of this section had to do with the making of chemical engineering calculations, the censoring of outgoing reports, the procurement and distribution of technical information, and the maintenance of the technical files in the Headquarters library.

Due to the urgent need for speed in chemical warfare work, there was a natural tendency for those in charge of different technical investigations to report the results of these investigations in a hurried and consequently inaccurate manner. Largely through the agency of the Confidential Information Section, it was possible for the work of the Development Division to be reported clearly and accurately to other Divisions in the Service.

The Headquarters officers are shown in the accompanying photograph.

DEFENSE SECTION, DEVELOPMENT DIVISION

Preliminary Period In the first phases of the charcoal development work at Nela, the investigation was carried on by the following men loaned from the Lamp Development Laboratory, the work being under the personal supervision of Mr. Dorsey: D. C. Hughes, Walter Ibele, W. J. King and Arthur Cather. For this work, Room 104 in Building 314 of the National Lamp Works was fitted up as a laboratory. The story of the work accomplished during this preliminary period of investigation, though highly important as to results obtained, can be told very briefly.

In beginning the development of an absorbent charcoal, the first obvious step was the determination of the most suitable form of raw material. A preliminary survey of the available literature on the subject showed that whereas the ability of various charcoals to absorb gases had been utilized, namely, willow charcoal in medicinal work and cocoanut charcoal in the production of high vacuums, still no data was at hand to show the exact relationship between the relative absorptive values of charcoals obtained by carbonizing different woods. In addition, though it was known that the carbonization schedule affected the absorptive value, or activity of the resulting charcoal, the information available indicated only that carbonization at temperatures above 650° C. gave a less active charcoal than carbonization at lower temperatures. The first work at Nela Park, therefore, was concerned with the distillation of all the more common woods by a definite schedule, the temperature being 625° C. This work, beginning about May 15, 1917, was performed by Mr. Dale C. Hughes under the direction of Mr. Dorsey. Some 300 distillations were made, and the absorptive power of the resulting products tested against chlorine gas. The direct result was the adoption of cocoanut hulls as the standard raw material for the production of absorbent charcoal.

Probably no individual engaged in any of the work on carbon put more self-sacrifice and devotion into his work than did Mr. Hughes. Originally connected with the Lamp Development Laboratory of the National Lamp Works, he worked as Mr. Dorsey's right-hand assistant from May, 1917 to April 1st, 1918. Later he had complete charge of the experimental carbon plant at Toledo, Ohio. In August, 1917, when Mr. Dorsey was sent to Astoria, Mr. Hughes was placed in complete charge of all the work at Nela Park. On April 1st, 1918, he was transferred to the Astoria plant, co-operating with the other men engaged in the carbon work there. About the first of June he was commissioned as First Lieutenant in the Sanitary Corps, and in July he was transferred, with the same rating, to the Chemical Warfare Service. His work from this time until February 21, 1919, when he received his discharge, consisted of further experimental work on carbon, and the application of the experimental results to carbon manufacture.

In connection with the above-noted results, considerable confusion was first experienced in the matter of judging the absorptive value of a given charcoal. This value was at that time given in terms of the time required for penetration by chlorine gas, but as yet the method for making the test had not been standardized. As a consequence, the absorptive efficiency of a given charcoal as determined at Nela Park would not check with values obtained on the same material as tested at other government stations.

The Nela Park organizations, therefore, undertook the development of a standard procedure for testing charcoal on the basis of chlorine gas. This work was largely performed by Messrs. Ibele and King. A satisfactory procedure was evolved, but just at this time it became apparent that chlorine as a gas warfare weapon would soon be superseded by phosgene and chlorpicrin. This necessitated a shift from chlorine to phosgene and chlorpicrin in the matter of testing the serviceability of experimental canister charcoal.

A method evolved by the Bureau of Mines, and based upon the use of chlorpicrin as the test gas, enabled a very accurate determination to be made. However, the Bureau of Mines procedure required entirely too long a period of operation for use in a laboratory where a large number of such tests had to be made daily. This "long method" was accordingly modified by Mr. King. The resulting "accelerated method," after certain later improvements, was ultimately adopted in this country as the standard procedure for testing the activity of the canister charcoal.

About June 30, 1917, work was begun by Mr. Dorsey and Mr. Hughes on the determination of the proper carbonization schedule for cocoanut hulls. A schedule was first evolved on a laboratory scale at Nela Park, and then the investigation was transferred to the plant of the Erie Street Gas Works, Toledo, Ohio, for large-scale experimentation. Here, through the kindness and courtesy of Mr. Henry L. Doherty, who for many years had been a highly valued friend and customer of the National Lamp Works, and the operators of the Toledo Company, a bank of unused gas retorts was loaned for the experimental work, Mr. Doherty personally assuming all the expense involved. Mr. Doherty also turned over his entire Toledo gas laboratory to Mr. Dorsey for a full week. Mr. Dorsey and Mr. Hughes spent a large part of the next six weeks in Toledo. The final schedule as worked out at Toledo became the standard carbonization practice in the production of absorbent charcoal, and was used at the Astoria Plant throughout the course of the war.

During the progress of the work at Toledo, the Research Laboratory of the National Carbon Company had developed on a laboratory and semi-plant scale a procedure for increasing the activity, that is "activating," the charcoal coming from the ordinary carbonization retorts. This procedure, called the "Air Activation Procedure," consisted essentially of reheating the charcoal in a current of air at 300° to 350° C., thus burning out the hydrocarbon impurities. The cocoanut charcoal obtained at Toledo was found to respond readily to this treatment.

Large-scale apparatus for the continuation of this development at Nela Park was ordered, but before this apparatus was received, the demand for canister charcoal became acute. Consequently this equipment was shipped to Astoria, where the Nela Park organization assisted in the installation of the complete equipment for carbonizing cocoanut hulls and air-activating the charcoal so obtained. Assistance was also rendered in the initial operation of this plant, the first drum of activated charcoal being shipped September 24, 1917.

During the installation of the Air Activation plant at Astoria, it became evident due to the increase in the charcoal program that there would be a shortage of cocoanut hulls. The Nela Park Laboratory, therefore, began a search for a substitute. This work was done largely by Mr. Hughes. The initial tests were made on the basis of air-activated material. However, during the progress of this investigation, work by the National Carbon Company demonstrated the apparent advantage of superheated steam over air as the oxidizing agent in charcoal activation. The final tests on cocoanut hull substitutes were accordingly made on the basis of steam-activated material. The result of this investigation led to the later adoption at Astoria of the "mixed" charge, mixtures of cocoanut and various fruit pit charcoals being activated together.

It was just at this time that the Steam Activation procedure, as evolved by the National Carbon Company, was turned over to Mr. Dorsey for large-scale development work. At this point begins the story of the Nela Park Gas Defense Detachment.

GAS DEFENSE DETACHMENT

By November 1, 1917, Mr. Dorsey had completed the installing at Astoria of equipment for the production of absorbent charcoal by the Air Activation process and was ready to take the new steam treating process developed by the National Carbon Company, and work out the different difficulties arising in putting it on a commercial production basis. Although Mr. Dorsey had several assistants from the National Lamp Works working under him, the development of the steam treating process demanded a much larger personnel.

Major Bradley Dewey, then officer in charge of the Gas Defense Service, agreed to furnish Mr. Dorsey with the required personnel of chemists and engineers for carrying on the new development work, and the National Lamp Works generously agreed to pay all costs for the work done at their plant. On November 14, 1917, Sgt. T. M. Rector, later Lieutenant, arrived in Cleveland with ten men. On November 15th, Lieut. J. R. Silver, Jr., was transferred from the National Carbon Company to take charge of the new detachment. Thus begins the history of the Nela Park Gas Defense Detachment.

One of the garage rooms of the National Lamp Works was taken over the morning of November 15th. Sgt. Rector was designated to plan, equip, and organize a laboratory for the necessary chemical control work. Privates were set to work at once assisting the carpenters in partitioning off the room. Sgt. Rector went to Pittsburgh and brought back as baggage the apparatus needed. One week from the morning that the garage was taken over, the laboratory was turning out tests on charcoal. At the same time work was started on the design of the first commercial-size unit.

The charcoal development work divided itself along two separate paths—the development of a commercial process for manufacturing charcoal, and the development in the laboratory of control tests and research work. Due to his experience in plant work, Lieut. Silver was in direct charge of the former, and Sgt. Rector, on account of his laboratory experience, was in charge of the latter. The organization of the detachment proceeded as the work expanded and as new men arrived. When first put into operation, the laboratory had a personnel of five men, consisting of Sgt. Rector in charge, assisted by Privates John P. Cheever, L. W. Larsen, J. A. O'Callaghan and Andrew Carsten. When the first furnace was started, the plant organization consisted of Lieut. Silver in charge, assisted by Privates Kean, Etter, Markovitz, Uhl, Thompson and Gair.

Although Major Dewey had kept his promise to Mr. Dorsey and sent him chemists and engineers, he seemed to have forgotten that such poor human beings had never been educated to War Department rules and regulations. Before many days had elapsed, unknown War Department orders began to drift in, and it was necessary to get a stenographer to keep the records, etc. For this purpose, Private Pipkin was "drafted," in spite of his protests that he was a chemist and not a stenographer. In spite of the hard work of the C. O. and Pipkin, it was necessary to send out an S. O. S. call to Washington for a real, skilled-in-paper workman. This S. O. S., for the time being, could not be answered and Pipkin continued to bear the burden of the office routine. On December 7th, Sgt. Frank Dobe reported for duty, in answer to the S. O. S. above noted. From this date on, most of the burden of solving military red tape orders rested on Sgt. Dobe's shoulders and to him belongs most of the credit for the fact that the Nela Park detachment was never "in Dutch" with Washington.

Men were being sent to this station daily, and as a man's ability was proven for either laboratory or plant work, he was shifted so that his ability could be best utilized.

On December 17th, Pvt. Keese reported for duty, having been inducted into the service for his ability as a draftsman. As constant changes in the design of the furnace required a man for designing alone, Keese spent most of his time in keeping designs up to date and in drawing up proposed changes.

On January 16th, Sgt. G. M. Rollason reported for duty and shortly afterward was designated to serve as Mr. Dorsey's special assistant. Much of the development work from this time on was due to suggestions of Rollason.

On January 25th, Pvt. Gracey joined the detachment and, due to his previous business experience, was immediately assigned to assist in the purchasing of materials and the keeping of accounts. Gracey gradually took over all work relative to the expenditure of money and the ordering and shipping of materials.

Throughout the entire first five months this station was run twenty-four hours per day, seven days a week. Men often worked seventy-two hours straight. The work was hard and tedious, and only by the entirely unselfish efforts of each individual man was success attained.

The specific object of the investigation at Nela, as before noted, was to develop, to a large-scale production basis, the steam process for the activation of charcoal, as evolved by the National Carbon Company organization. This process consisted essentially in exposing charcoal, obtained by carbonizing cocoanut hulls, to steam at a temperature ranging from 850° C. to 1000° C. until the required density reduction was obtained. The average time of treating was one hour, using a steam-charcoal ratio of about one to one by weight.

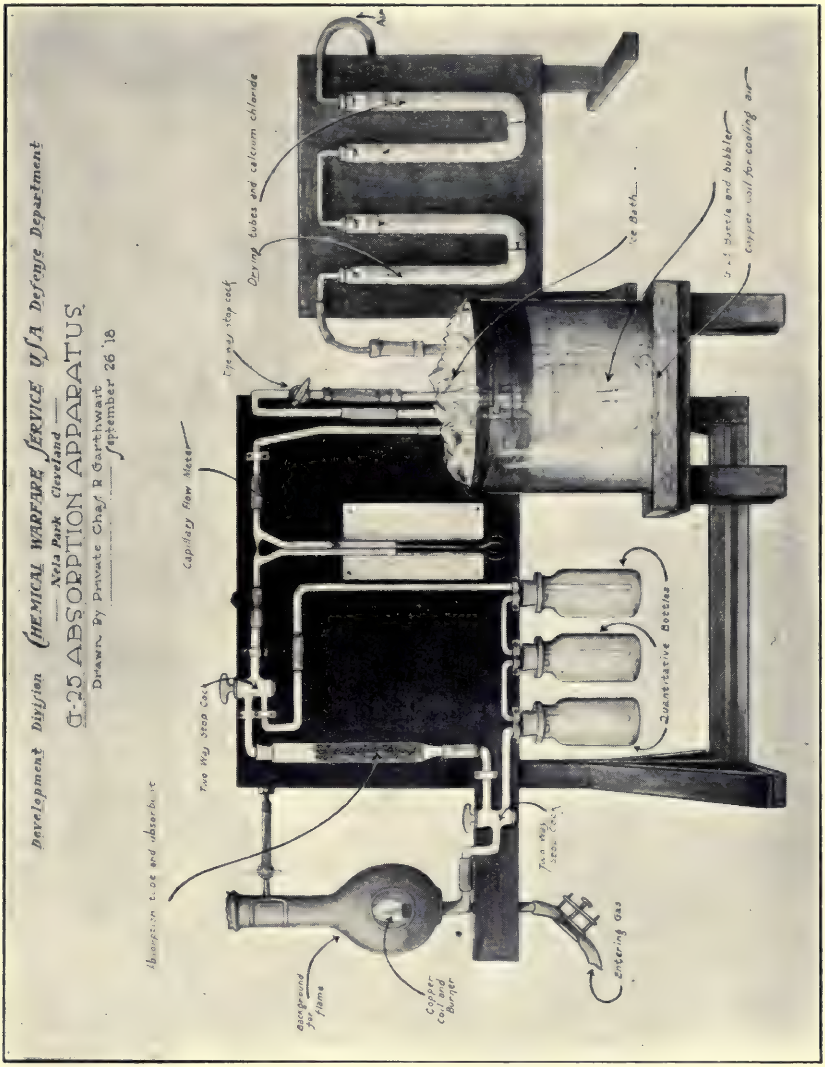
The problem now to be solved was a difficult one. For the sake of heat conduction, it was essential to use a metallic installation. At the same time, no furnace tube had as yet been developed with a demonstrated ability to withstand the conditions proposed. One large manufacturing concern, when approached on the subject, declared that the thing was impossible. The successful answer to this problem at Nela Park represented a real engineering feat.

No attempt will be made to give a detailed account of the development of this furnace, or "Dorsey Treater" as it is called. It is a very interesting, but at the same time a very long story. This particular investigation at Nela Park began in November, 1917, and continued until November, 1918. In all, nine furnaces or units were erected and operated. It so happened, however, in February, 1918, while the Nela organization was still experimenting with Unit Number 4, the canister charcoal situation became so acute that it was deemed inadvisable to await the development of a more perfect process. Unit No. 4 was giving fairly satisfactory results, so, in March, the Nela organization began assisting in installing at Astoria ten units of this type. The investigation was continued in Cleveland and, through the results obtained from Units Nos. 4 to 9 inclusive, certain modifications in designs and operation were evolved for the benefit of the Astoria plant. The basic principle embodied in Unit No 4, however, was never really changed. A brief description of this unit will be sufficient in an account of this nature.

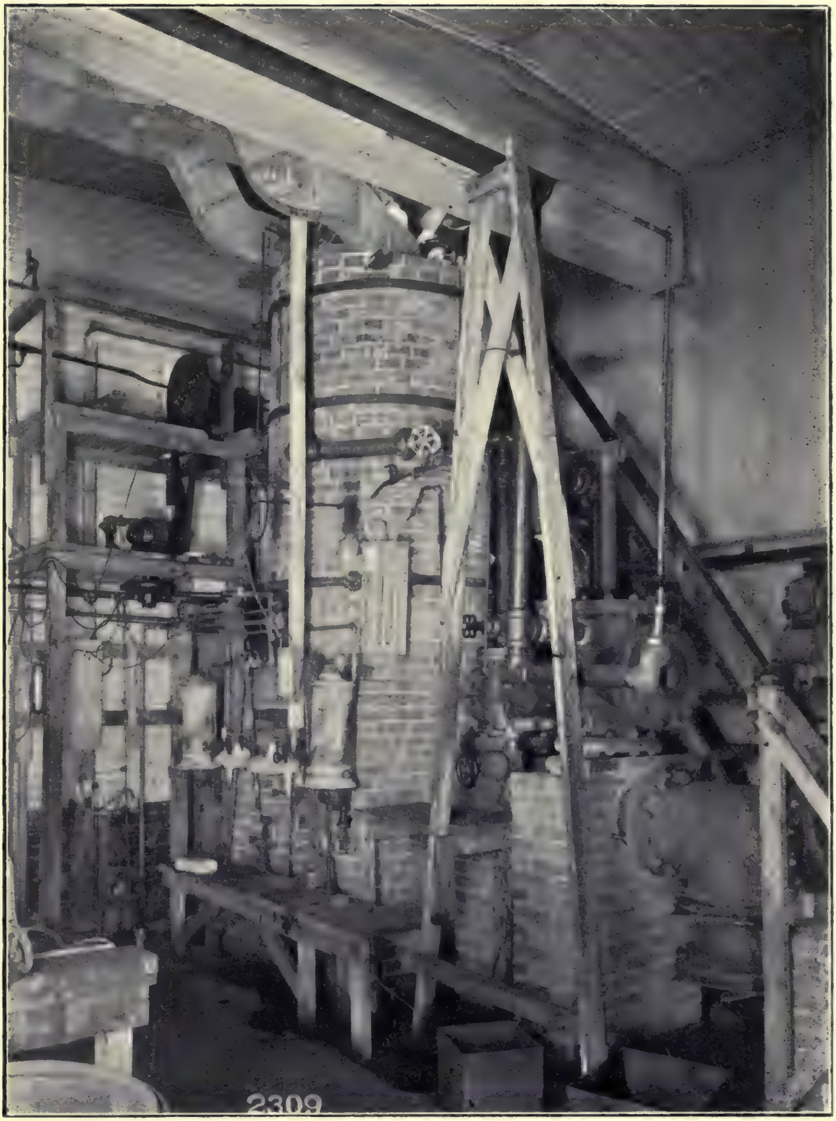
Unit No. 4, the unit adopted at Astoria, consisted of a vertical nichrome tube 7 feet long by 7 inches inside diameter, set in the middle of a combustion chamber of firebrick, and heated by surface combustion with natural gas. The charging device consisted of two slide valves so arranged that charcoal could be introduced into the tube without allowing the escape of gases or the access of air into the tube. Similar valves were provided for the lower or discharge end. Suction was applied to the top and bottom of the tube in order to draw off the water gas formed in the reaction.

The introduction of steam in such a manner as to give the proper distribution had required considerable experimentation, and in fact in Unit No. 4 the problem of this steam distribution had by no means been solved. In Unit No. 4, however, the steam was introduced by means of two-inch pipes perforated with 1/8-inch holes. These pipes brought the steam into the tube in two places, one just above the hottest zone in the furnace, and the other about 18 inches to 20 inches above the first.

The tube was to be filled with charcoal brought to the proper temperature, and the superheated steam admitted. As the finished product


Development Division CHEMICAL WARFARE SERVICE USA Defense Department
— Nela Park Cleveland —
G-25 ABSORPTION APPARATUS
Drawn By Private Chas R Garthwait
September 26 '18
Air
Drying tubes and calcium chloride
Ice Bath
[illegible] bottle and bubbler
Copper coil for cooling air
Three way stop cock
Capillary Flow Meter
Two Way Stop Cock
Quantitative Bottles
Absorption tube and absorbent
Two way stop cock
Entering Gas
Background for flame
Copper coil and Burner

The G-25 Absorption Apparatus which was used to determine the Absorption Value of different Forms of Charcoal



Dorsey Treater Number Four, Used for the Large-Scale Steam Activation of Charcoal was discharged below, new material was charged into the top of the furnace. This material, as it travelled down the tube, gradually heated up until it reached the upper steam zone. The partial activation received here was to be completed by the second activation treatment received when the material passed the second or hottest zone.

At least thirty runs were made with this furnace, and it was found that under normal operating conditions, charging 40 pounds of charcoal per hour, an activated charcoal could be obtained having very satisfactory absorbing qualities. Certain modifications were made in the unit when installed at Astoria, but these were all of minor character, the principal design of the unit being retained.

In the development of the steam activation process, Mr. Test of the Cleveland Wire Division of the National Lamp Works was loaned to Mr. Dorsey by Mr. Benbow to assist in the development of furnaces using surface combustion as a heating medium. The efficiency of the various units used in the development of activated charcoal is due to the splendid efforts of Mr. Test.

As stated above, the investigation was continued at Nela Park, and other furnaces were erected. An account of the results obtained from these furnaces is given in later pages.

While the development of the Dorsey Treater was progressing in the plant, the laboratory side of the investigation was being well cared for by the men to whom this duty had been assigned. When first put into operation, the personnel of the laboratory consisted of five men, with Sgt. Rector in charge. From this nucleus the laboratory force grew until, on the first of March, 1918, a total of seventeen men was on its staff.

At this time Lieut. Silver, then Commanding Officer of the Detachment, was transferred to Astoria, and Sergeant Rector was commissioned 1st Lieutenant, and given the position of Commanding Officer. This necessitated reorganization of the laboratory personnel. Sergeant Cheever was placed in charge of the operation of the control laboratory, and Sergeant O'Callaghan was given direction of the activities involved in the research work. This arrangement was in force for about two months, when it was deemed expedient to turn over all the laboratory work to Sergeant O'Callaghan, thus making Sergeant Cheever available for plant work. At the time of the organization of the Chemical Warfare Service, the laboratory had a force of twenty-six men engaged in research and control work.

In connection with the development of the steam treating process, one of the first tasks facing the control laboratory was to produce a method of testing charcoal which would be quick and accurate. Mr. Dorsey's laboratory was using the "accelerated method," which took about one-fifteenth of the time required by the "long method." The details of this method, however, had not been as yet perfected. Under the personal direction of Sergeant O'Callaghan, the apparatus was improved and its operation rapidly standardized. The unreliability of the various methods in use at other laboratories and the apparent advantages of the Nela Park method brought it to the front when a conference was called in January for the purpose of adopting a standardized procedure for universal use. The Nela Park method was adopted at this conference, and, from that time on, was used at all laboratories of the Defense Service.

Later, with the development of other absorbents, it also became necessary to modify the existing procedures for testing charcoal against phosgene and arsine.

In following up the plant development work, a large number of these control tests were required. In fact the control laboratory was one of the busiest spots at Nela Park.

The first research work undertaken in the laboratory was to determine under what conditions one gas is replaced by another in the charcoal. This work was performed by Private Etter, who was the first man to be put on work of a purely research nature. The results obtained were interesting but never attained to any practical application.

During the latter part of January, 1918, research work was started on impregnating charcoal with various compounds, the idea being to increase its neutralizing power for such gases as arsine, cyanogen chloride, etc., which had not been used by the Germans as yet, but against which it was believed we should be prepared. No results of any importance were obtained in this respect until later in the year, as will be noted.

While the charcoal impregnation work was just beginning it became quite evident that research work was being handicapped through the lack of laboratory facilities. The numerous control tests necessary for checking up the experimental steam treating furnace had been increasing in number, and the control work was practically utilizing all the floor space of the laboratory. So, early in February, another laboratory, to be used exclusively for research work, was built and equipped. This laboratory was completed by the end of the month and an increased impetus was thereby given to work on research problems.

One of the first discoveries to come from the new laboratory was the fact that the activity of charcoal for phosgene could be enormously increased by the introduction into it, under certain conditions, of hydrated manganese dioxide. This development was due to the work of Pvt. Marvin Pipkin. It was later shown that other related metallic hydrates would perform the same function to a greater or less degree. It was also afterward shown that the efficiency of the impregnated charcoal was due to the water held and not to the hydrate itself. This led to accurate determinations of the effect of water on the absorption of gases by charcoal.

Another development arising from the results on impregnation with metallic hydroxides was the discovery by Pvt. Lawrence W. Larsen, that charcoal impregnated with ammonia gas and afterwards evacuated, had its capacity for absorbing arsine enormously increased. The increase in many cases was more than one hundred per cent. This discovery would undoubtedly have gone into production but for the fact that the laboratory soon turned out an absorbent equal to "Larsenite" in arsine absorbing power and much superior to it with regard to phosgene, namely, "Rankinite A."

In the work on Rankinite A, the research laboratory thus returned to its earlier work on impregnated charcoals. It soon became apparent that in this material the research laboratory had made a very promising discovery. All the men available were shifted upon the new problem. At the time of the formation of the Chemical Warfare Service, Rankinite A was being made at Nela Park in fifty-pound batches. Its later development proved to be one of the big achievements of the Defense Section of the Development Division. However, the only thing we are allowed to divulge about Rankinite A is the fact that the name is a composition of the names of the two men largely responsible for its discovery, Pvts. Randolph and Pipkin.

In addition to the independent investigational work performed in the laboratory, a great deal of co-operative work was done in connection with plant development. Both the research and control laboratories had been constantly at the disposal of the development department to work out any details as requested. A large amount of data on the flow of gases in the treater unit and of thermo-chemical data on the chemical reactions involved was the product of the research staff. Plant development and research men were continually interchanged between the two departments, whenever such changes were to the advantage of the work and to the men themselves.

On March 1, 1918, Lieut. Silver, who up to this time had been Commanding Officer of the Nela Park Detachment, was transferred to Astoria, L. I., for the purpose of supervising the installation and operation of the new steam-treatment process, as then developed. Lieut. Silver's work was thereupon turned over to Lieut. Thomas M. Rector. The detachment at this time consisted of thirty-five men and two officers, divided into two approximately equal divisions, one division devoted to the plant development work, and the other to laboratory research and control work. In August, when the Nela Park Gas Defense Detachment was transferred to the Chemical Warfare Service, as the Defense Section of the Development Division, the personnel of the detachment had been increased to about eighty officers and enlisted men. At that time Lieut. Rector was transferred, and the command passed first to Captain Guy Cowan, and, a month later, to Capt. O. L. Barnebey.

TRANSITION FROM GAS DEFENSE TO CHEMICAL WARFARE SERVICE

On June 28th, Lieut. T. M. Rector left his post and duties as Commanding Officer of the Nela Detachment to assume duties at the Long Island Laboratories of the Gas Defense Service in New York City. He was succeeded in command by Lieut. J. R. Silver, Jr., who had just returned for duty in Cleveland. Lieut. Silver, however, was only technically in command of the detachment, being engaged at this time on work in the Offense Department. The actual executive duties were performed by Sgt. J. A. O'Callaghan.

The detachment was just at this time in the process of re-organization, being transferred to the Chemical Warfare Service. As a result of the transfer, the Development Division of the Chemical Warfare Service was formed. Under this new organization the old Gas Defense Service Detachment became the Defense Department of the Development Division, Chemical Warfare Service.

The commissioned and enlisted personnel was increased rapidly at this time. The enlisted personnel increased from 35 men in June to 80 men in July. The commissioned personnel was increased far more in proportion. Of the original Gas Defense Detachment, the following men were commissioned as Second Lieutenants in the Chemical Warfare Service—Gracey, Dobe, Rice, O'Callaghan, Cheever and Weber. The following civilians were also commissioned as Captains—O. L. Barnebey, R. G. Cowan, Edward Hering. M. B. Cheney was commissioned First Lieutenant.

By the original plan of organization, Capt. Cowan was scheduled to act as commanding officer of the Department, but due to a change in plans he was transferred to the Experimental Plant. In his stead, Captain O. L. Barnebey was made commanding officer of the Defense Department, with Lieut. M. B. Cheney second in command.

During this brief and somewhat unsettled period, July 1st to August 1st, the organization had materially changed. When Lieut. Dobe was transferred to Headquarters to act as Adjutant for the Development Division, the army paper work and personnel record suffered for a time until the duties were finally assigned to Supply Sergeant Laubenstein.

When Lieut. Gracey was transferred to the Experimental Plant, the duties of purchase and procurement were taken up by Lieut. L. V. Weber. Later Lieut. Weber was transferred to the Zanesville Detachment, where he worked in connection with the operation of the Dressler Tunnel Kiln. He was succeeded in his responsibilities by Regimental Supply Sergeant H. M. Miller, assisted by Sgt. C. A. Humel. Sgt. Miller had been identified with the Defense Department for almost a year, and in that time he had acquired a thorough understanding of all business requirements of the Department, and of the more or less complicated relations of the War Section to the National Lamp Works.

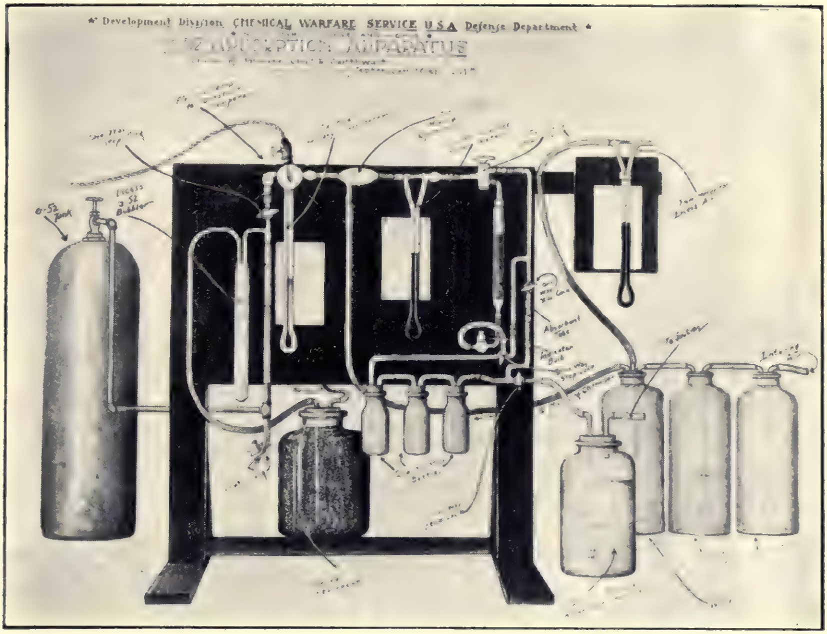
In the drafting room, Sgt. Keese was with the Department for over a year and a multitude of drawings bear his initials. Sgt. Krafft and Pvt. Salisbury were also identified with this work.

When the Defense Department of the Development Division was definitely established on August 1st, the organization was headed by Capt. O. L. Barnebey, with First Lieut. M. B. Cheney as his assistant.

The work of the department was divided into separate sections for the different problems and processes being developed. These sections were in the immediate charge of various men, as is explained later in detail. However, Capt. Barnebey kept in very intimate touch with every problem in progress, and in most cases was very active in working out all the details. To do this meant that he had to be on the job every minute of the day, and some of the men would be willing to vouch that this last statement is literally true.

Lieut. Cheney, right-hand man to Capt. Barnebey, was later made Commanding Officer of the Defense Detachment at the plant of the American Encaustic Tiling Company, Zanesville, Ohio, where the Dressler Tunnel Kiln was adapted for the activation of carbon.

It should be stated here that while the organization was divided into small units working on the various problems, there had at all times been the closest co-operation among the men. Any man who was especially adapted for some special problem in another department promptly lent his entire knowledge to that work. In this way the technical knowledge and man-power of the departments was always utilized to a maximum of efficiency.


Development Division CHEMICAL WARFARE SERVICE U.S.A. Defense Department
G-52 Tank
Excess G 52 Bubbler
Absorbent Tube

Upper Photo—The G-52 Absorption Apparatus used to determine the Absorption Value of Charcoal for various Impregnated Compounds.
Lower Photo—The Research Laboratory of the Defense Section, Development Division.

Upper Photo—The Control Laboratory which was used in the Development Work on Methods for Testing the Absorption Value of Charcoal.

Lower Photo—The G-25 Testing Boards used in the Control Laboratory.

RESEARCH LABORATORY

Previous to the time of the organization of the Development Division, the Research Laboratory had a staff of only six or eight men and their activities were confined to laboratory problems and the work was conducted entirely on a laboratory scale. In the new organization, the method of handling problems and the nature of the problems themselves were changed and the efforts were directed entirely toward commercial development.

Because of the nature of these new problems above mentioned, the personnel was greatly enlarged until there was at one time a maximum of thirty men engaged in research work, Lieut. J. A. O'Callaghan being in charge. The facilities of the Research Laboratory were correspondingly increased at this time to satisfy the needs of the larger organization.

The problems of the Research Laboratory were so varied that any comprehensive survey of the work done is impossible here. Several problems on which a very extended study was made deserve special mention. These problems can be summarized under the following titles:

1. The development of an impregnated charcoal suitable for the absorption of all war gases and a method for its manufacture.
2. Development of the Steam Lift Furnace for the activation of carbon.
3. A study of the effect of humidity on the activity of charcoal.
4. Development of a substitute for cocoanut charcoal for absorption purposes.
5. Possibilities of the utilization of carbon dioxide, nitrogen, oxygen, and mixtures of these gases as activating agents for carbon in steam treater.
6. The effect of pressure on absorptive capacity of charcoal.
7. The removal of salt from peach and apricot pit charcoal.
8. The production of briquettes for carbon fines and various binders.
9. Microscopic studies of various absorptive charcoals.
10. Special studies conducted in a small horizontal gas-fired treater (a modification of the Dressler Tunnel Kiln).

The Research Laboratory was not, of course, independent of the rest of the organization in handling these problems. It enjoyed the hearty co-operation of all parts of the organization. As fast as research developed, it was adapted to plant operation.

CONTROL LABORATORY

The control laboratory was well equipped for the control of all plant and research operations. The analytical control laboratory was directly in charge of Lieut. J. P. Cheever, assisted by Sgt. T. C. Smith and Sgt. R. E. Selkirk. In this laboratory considerable work was done in the development of analytical methods, especially those for testing the absorptive value of charcoal. Mr. E. J. Haefeli, whose services were given by the National Lamp Works to the department for the duration of the war, aided greatly in the work of the construction of apparatus by his expert glass-blowing ability. He also materially aided the Gas Defense Plant at Astoria, L. I., by his work there. In fact, testing boards made by him were sent all over the country. Almost all the chemists of the Department at one time or another had an opportunity to work in this laboratory.

When the Zanesville Detachment was formed, Lieut. Cheever and Sgt. Smith established a model control laboratory in record time. Supervision of the Nela analytical laboratory was performed by Sgt. Selkirk until the close of the activities of the Department.

PLANT ACTIVITIES

In the plant itself, a large number of interesting developments were realized in connection with the activation of charcoal.

Compression Retort Development Based on the preliminary work performed at the Forest Products Laboratory at Madison, Wis., by Dr. L. F. Hawley and Mr. Ernest Bateman, there was built in the Defense Department a semi-plant-size unit which was called the Hawlite Compression Retort. This unit was designed to accomplish carbonization of wood waste which had been previously briquetted at high pressure. The carbonization was carried out at relatively low temperatures and the briquetted material which was being carbonized was subjected to pressure during the entire process of carbonization.

The experimental work performed in the Defense Department at Nela was directed by Dr. Hawley personally. He was assisted by Sgt. W. H. Watt and Sgt. A. T. Cowley.

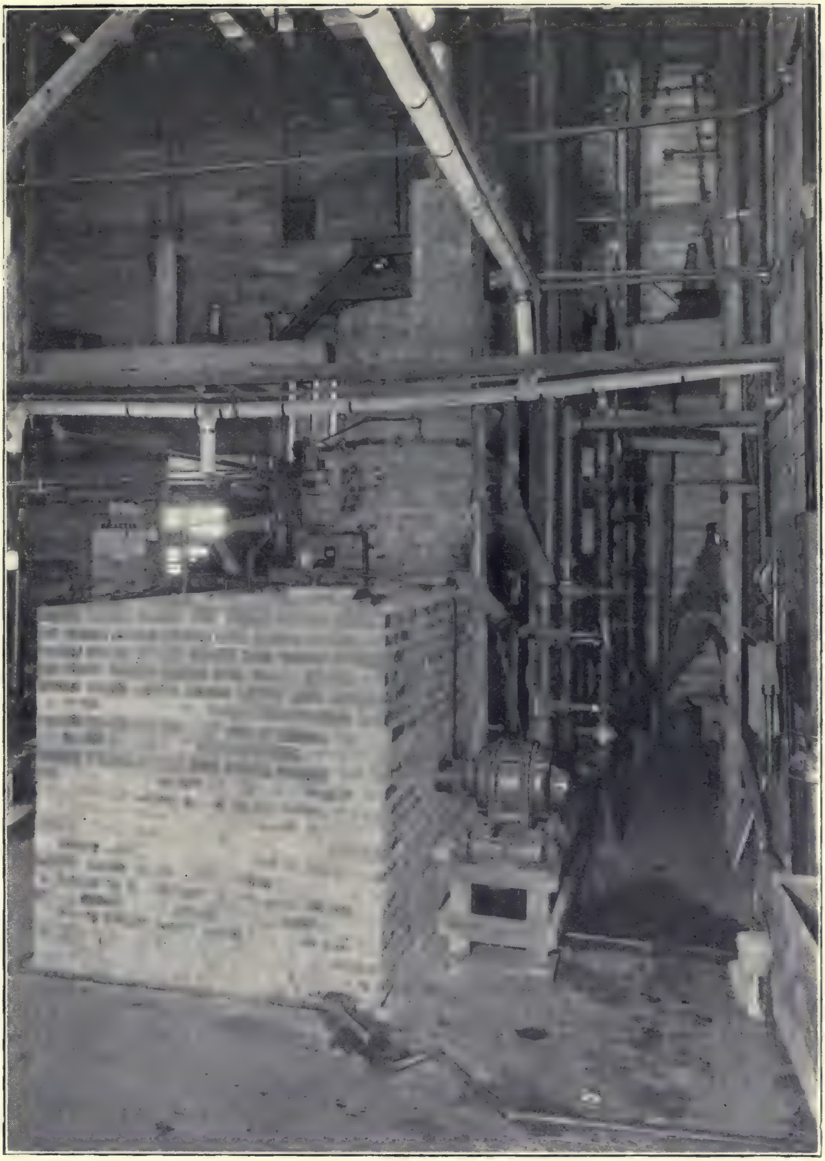
An elaborate series of experiments was performed with this unit, carbonizing briquetted material and woods of various kinds. The possibility of using this method of treatment of wood and wood waste to produce charcoal in case of shortage of other material for activation purposes, was proven to be very good.

In connection with this work Mr. Bateman carried on a study of the activation of carbon by means of carbon dioxide with results analogous to those obtained at Nela Park.

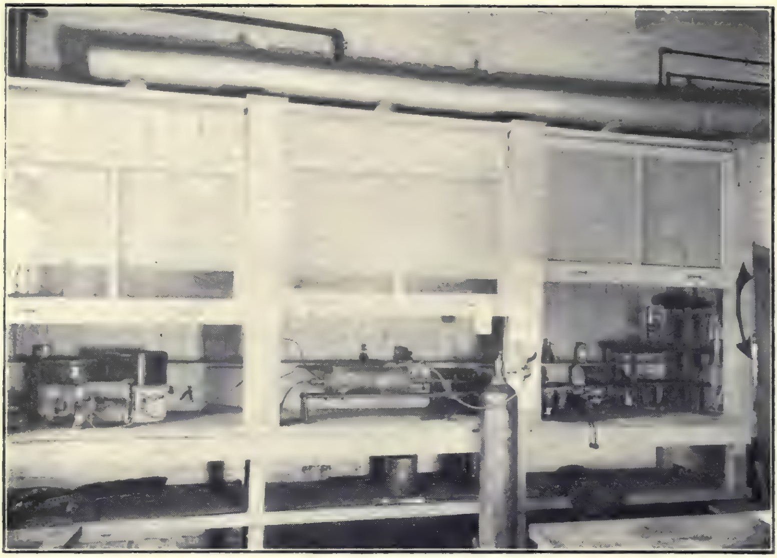
Dorsey Treater Development Lieut. W. W. Rice was directly in charge of the later development of the Dorsey Treater. Sgt. 1st-Class D. W. Rose was his assistant in this work. Under Lieut. Rice's direction, there were constructed five Treater Units (Nos. 5, 6, 7, 8 and 9) in an effort to improve the Dorsey Treater as developed by the Gas Defense Detachment, from a standpoint of durability, ease of operation and quality of product.

With Unit No. 5, a composition graphite tube was used in an effort to replace the more expensive nichrome. The use of this type of tube was abandoned by reason of its low heat conductivity. Unit No. 6 was another nichrome furnace. This furnace was run at a higher operating temperature in an effort to secure a higher quality of product. A better quality product was obtained but the temperature was so intense that the life of the installation was limited to a few days of continuous operation.

Unit No. 7 was the first unit to be entirely free from gas pockets and the various troubles arising from them. This unit marked the first real step toward the elimination of the operating difficulties that were experienced in all previous installations. However, this was done at the expense of the



The Dorsey Treater Number Nine—the Latest Type of Vertical Steam Activator Developed at Nela Park



Upper Photo—The small Experimental Electric Furnace Developed for the Steam Activation of Charcoal.

Lower Photo—Wedge Furnace No. 1, which was the first Horizontal Activator Developed.

chlorpicrin activity of the material produced. The relatively low chlorpicrin activity of the material produced in this unit was found to be due to the very uneven vertical temperature distribution, caused by the withdrawal of all the gases incidental to the process of reaction from the bottom of the furnace.

In Units Nos. 8 and 9 progress was made in the further elimination of the operating difficulties, in the improvement in the vertical temperature distribution and subsequent increase in the chlorpicrin activity of the product.

Unit No. 9 represented the very latest type of vertical steam activator developed at Nela Park. It was nearly free from all mechanical defects, as well as from operating difficulties. It was the opinion of this department that this unit represented the best that was obtainable with this particular type of steam activator.

The Dorsey Treater had been a pet of the Defense Department. There was never a time in the life of this department when there was not a treater of this type either in construction, operation or in the process of being dismantled.

Electric Furnace Development The work of developing an electric furnace suitable for the activation of charcoal was in charge of Lieut. Wm. D. Van Arnam. Lieut. Van Arnam came to the Defense Department from Midland, Mich., where he had been stationed as a civilian doing experimental work in connection with mustard gas manufacture. He was commissioned just before his arrival at Nela Park. He was assisted in this work by Master Engineer Atwell, Sergeant R. G. Lafean and Sergeant C. A. Teeple.

The problem of developing a satisfactory electric furnace for the activation of charcoal was one of the most difficult experimental processes that the organization encountered. The work was in reality a pioneer investigation and was undertaken to find out if the carbon activating process could be more rapidly brought about at a temperature of 1500° to 1600° C.

The advantage of an electric furnace over the ordinary furnace for heating any kind of material lies in the higher temperature that it is possible to obtain with such an installation.

In attempting to fulfill the temperature requirements, much difficulty was encountered in securing suitable refractory material. Charcoal offered a very high resistance to the passage of the electric current and required a large power input which necessitated the installation of special electrical equipment, i. e., switches, transformers, bus-bars, etc.

It was necessary to conduct an extensive experimental study to establish the adaptability of commercially obtainable, suitable refractories. An extended study of the varying resistance of various types of charcoal had to be made also. Several units were erected for the activation of charcoal. The experimental results obtained seemed to prove quite conclusively that the high temperatures were not desirable for the activation of carbon, and hence no adaptation of the electrical resistance principle was employed on a commercial production basis.

Wedge Furnace Development The development of the Wedge Furnace design was directed by Mr. Utley Wedge, Consulting Engineer from Philadelphia, Pa., in co-operation with the Department. Part of this work was performed at Nela Park and part at Philadelphia. Mr. Wedge, a furnace man of wide experience, was assisted throughout all the work by Sgt. 1st-Class W. G. Randolph. In the performance of the original work, much credit is also due to the careful working out of detail by Sgt. Andrew Karsten, Pvt. R. K. Carleton and Sgt. James Burns. All the carbon activation experience of the department was available for this work and the facilities were utilized until the completion of the first design.

Under Mr. Wedge's direction, a small unit known as Wedge Furnace No. 1 was erected. This installation was a departure from any carbon activator then in use. The purpose of this work was to find out if carbon while flowing mechanically over a series of hearths could be activated by steam in the presence of the furnace gases. Inasmuch as the hearths in this furnace were horizontal, a rabble system was used to give movement to the charcoal charge. To work out the data on flow of carbon over inclined hearths, suitable hearths of wood and ceramic construction were erected and the necessary data on angle of inclination and control of movement was obtained.

After the completion of the experimental work, Mr. Wedge, accompanied by Sgt. Randolph, returned to Philadelphia, where they continued and completed the work of the design of a furnace of the Scott type. In this type of furnace the flue gases are used to carry heat into the furnace In the activation of carbon, the flue gases furnish the carbon dioxide and some of the necessary steam for the process. The remainder of the steam is introduced as such. At the time of the signing of the armistice, the furnace design had been accepted and contracts were pending for the materials for the construction of the Wedge Furnace at the National Carbon Company, Cleveland, Ohio.

DEVELOPMENT OF DRESSLER TUNNEL KILN

At the completion of the experimental work applied to the Wedge design of the Scott type of furnace, the work of activation of uniform layers of various carbon materials was started. This work was carried out on a very thorough and elaborate scale. The work was pioneer in that it relied upon the penetration of the re-active gases into the varying depths of charcoal in even uniform layers. This method of activating charcoal utilizes a low temperature and prolonged time, thus giving small loss and maximum activation. The preliminary work and subsequent investigational work added greatly to carbon activation problems. The theory and practice of this development were entirely new and the Dressler Tunnel Kiln was the first commercial application of the same.

The work required very careful control of operating conditions, especially as regarded temperature. The original Wedge furnace in which this work was started was poorly adapted to this study. It was used for some time inasmuch as it was already erected, but was later discarded and a special furnace constructed for the purpose. This work progressed rapidly and the final application to the Tunnel Kiln type furnace was made with the Dressler Kiln, available at Zanesville, Ohio.

This furnace was made available through the kindness of the American

The Charge End of the Tunnel Kiln Type of Furnace. An empty and a loaded truck are seen in the left foreground

The Tunnel Kiln Furnace Shifts Unloading Respirator Carbon, Filling and Striking Trays and loading Crude Carbon

The Nela Camp Dining Room. It was equipped as a temporary hospital for the Defense Section during the Influenza Epidemic

The Personnel of the Defense Section, Development Division

Encaustic Tiling Company, of which Mr. H. D. Lillibridge was manager. The Defense Department was indebted particularly to Mr. Lillibridge, Mr. F. K. Pentz, Mr. Wm. McCoy and Mr. J. G. Whitmer of the American Encaustic Tiling Company for the courtesies and technical information received from them.

A detachment of about seventy men was formed at Zanesville with Lieut. Cheney as Commanding Officer, assisted by Lieuts. Weber and Cheever. Experimental work was carried on for about two months, to work out the necessary mechanical details required for successful activation. The kiln as a carbon activation plant was successful. This process is unquestionably the best developed for the activation of carbon during the war.

It may be said of this process that the only matter of regret is the fact that it was not discovered until the urgent need for activated carbon was over. The kiln had a great advantage in being equally suited for activation of all classes of carbon material. The activation secured, being in all cases almost the maximum obtainable, was secured in a single treatment of the material and without excessive loss. In connection with this adaptation there were many difficult problems involving a great deal of hard, mechanical work.

Steam Lift Furnace

As a final development in the experimental work on the activation of charcoal by the air or steam lift principle, a plant-size steam lift furnace was constructed in the Defense Department. The design adopted was the outcome of previous work by the Research Laboratory, and was made by Master Engineer L. W. Larsen. Capt. Hering and Sgt. Watt had charge of the construction of the unit.

Operation of the unit was successful and, with slight modifications in design, it was recommended for the production of a large amount of good quality material at a minimum expense for installation and operation.

Vertical Treaters

As has been said under the account of the Research Laboratory, a number of small vertical treater units were erected in the Defense Department for the study of the relative value of different gases as activating agents. These vertical treater units were essentially small-size Dorsey Treaters. 1st-Sgt. J. G. Williamson designed, erected, and was in charge of operation of two gas-fired units of this type, and Pvt. 1st-Class N. P. Uhl constructed a number of small electrically heated units of this type.

From the operation of these units, much valuable data was obtained on the use of steam, carbon dioxide, and mixtures of steam and carbon dioxide as activating agents. Many small-scale experimental runs were also made to test the efficiency of the Dorsey Treater for the activation of proposed Dorsite substitutes, and for the manufacture of Rankinite "A."

Distillation Retort

For the carbonizing of raw material, a gas-fired distillation retort was erected on a semi-plant scale. 1st-Sgt. Williamson designed, constructed and operated the unit. Many different kinds of wood and nuts proposed as substitutes for cocoanut hulls were carbonized in the retort, the charcoal so produced being subsequently activated in the small vertical treater units.

Records and Reports The many kinds of experimental investigations which were conducted simultaneously in the Defense Department required a large amount of work on the keeping of records, the collecting and systematizing of experimental data, and the writing of reports on the work done. By far the greatest part of this work was done by Sgt. L. C. Lamb. As the work increased in volume, Sgt. L. H. Hauth was added to the report department, and later Reg. Sgt.-Major P. Learoyd was recruited from the Research Laboratory.

Plant Construction In the earliest stages of the department, all the men having construction capabilities were identified with plant construction work. In fact this relationship of construction was never completely divorced from the work at any time. Prominently identified with the supervision of construction appear the names of Lieut. Rice and Sgt. Forrer, who were for several months connected with erection work of large-scale units in the Defense Department.

Sgt. Watt was the man who handled the later construction work for the Defense Department.

AKRON DETACHMENT

To assist Major Pierce in the development of the latest form of gas mask, known as the "Pierce Mask," a small detachment of men from the Defense Department was established in Akron, Ohio, at the plant of the Goodrich Rubber Company. The detachment consisted of Lieut. T. M. Rector, Sgt. Roland Etter and Pvt. Proser.

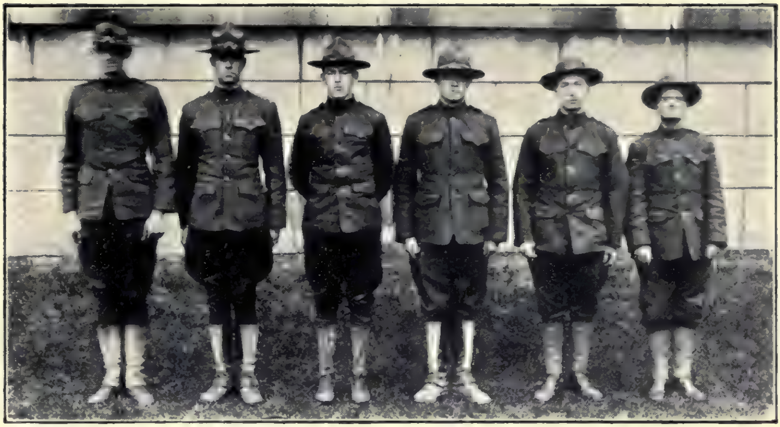
Various phases of gas mask construction were studied, and the work successfully resulted in one of the best masks developed during the war.

HONOR ROLL OF DEFENSE SECTION

Private J. L. Jordan.	Died October 15, 1918, from Influenza.
Private E. E. Washburn.	Died October 16, 1918, from Influenza.
Private E. M. Anderson.	Died October 20, 1918, from Influenza.
Private John Schwartz.	Died October 22, 1918, from Influenza.
Private C. E. Cooper.	Died December 8, 1918, from Influenza.

To the men who worked with them, lived with them and knew them for what they were, their deaths were indeed a loss, a source of deep sorrow and of sincere regret.

At the time of the influenza epidemic, a hospital was improvised on the Nela Camp grounds, Nela Park, for the care of the men of the Chemical Warfare Service. It is at least a source of satisfaction to know that everything possible was done for the men of the detachment who were afflicted with this insidious disease, and that all received the best that intelligent nursing and efficient medical attention could produce.



The Tray Production Crew, Zanesville Detachment, Development Division.

The Material Handling Crew, Zanesville Detachment, Development Division.

The Zanesville Detachment, Development Division, Zanesville, Ohio.

Shift Number One—Furnace and Control Laboratory, Zanesville Detachment, Development Division.

Shift Number Two—Furnace and Control Laboratory, Zanesville Detachment, Development Division.

Shift Number Three—Furnace and Control Laboratory, Zanesville Detachment, Development Division.

OFFENSE SECTION, DEVELOPMENT DIVISION

EARLY PRODUCTION OF MUSTARD GAS

On pages 167 to 170 we have briefly outlined the introduction of mustard gas into modern warfare by the Germans at Ypres, July 20, 1917. It is the purpose of the following discussion to give, in some detail, the general nature and properties of the gas itself, and the various problems and incidents connected with its development and production.

Mustard gas, or dichlorethyl sulphide, when pure is a water-white liquid boiling at 219° C. It was first prepared in 1886 by the German chemist Victor Meyer, who recorded its peculiar toxic properties. However, dichlorethyl sulphide had been generally regarded solely as a chemical curiosity, until the time when it appeared on the battlefields in Flanders.

Nobody in the allied countries had ever attempted to produce the stuff in any quantity and, on examination, the procedure used by Meyer, namely the chlorhydrin procedure, proved to be very unsatisfactory for large-scale production. In addition, the development of a satisfactory generator for producing ethylene gas had proved to be a stumbling block. It was as late as February, 1918, before Professor Pope in England reported the synthesis of this compound by the absorption of ethylene gas in sulphur monochloride. Strangely enough, the British cablegram anticipated by just two days the discovery of the same reaction at the American University in Washington.

The American University immediately put an entire laboratory on the problem, and by the middle of March a procedure had been indicated on a laboratory scale for the manufacture of this material, using sulphur monochloride and ethylene gas as the raw materials.

To develop this procedure, an experimental plant, shown in the accompanying photograph, was established March 12, 1918, in Cleveland, Ohio, at East 131st Street and Taft Ave. The plant taken over for this work, formerly the property of the Great Lakes Refining Company, consisted of a small, brick, two-story office building connected with a large single-story structure suitable for plant operations. This property, valued at $90,000, was located about six miles from the Cleveland Public Square, being adjacent to the Chandler Motor Company, the H. J. Walker Company and the Willard Storage Battery Company.

The district was rather congested for the handling of a toxic material like mustard, and unusual caution had to be exerted at all times to avoid "gassing the neighbors." In spite of this handicap, no serious trouble was experienced, and in general but few outsiders were ever aware of the nature of the work being done at the East 131st Street post.

The first commanding officer was Captain B. B. Wright, and the initial personnel consisted of seven officers and twenty-eight men, loaned from the Edgewood Arsenal.

No time was lost in putting the plant in shape for experimental work. The second-story room was quickly converted into a control and research laboratory, being furnished with ten well-ventilated hoods and all the equipment necessary for a modern laboratory. This laboratory was placed in charge of Lieutenant W. A. Felsing (later Captain). Upon Lieutenant

Felsing's transfer to Edgewood in July, Lieutenant R. A. Wilkins was placed in charge of the laboratory.

In the plant itself, rapid progress was made in installing the experimental production apparatus. Sergeant G. L. Rollason (later Captain) was in charge of the ethylene generators. Lieutenant W. D. Marshall directed the work on the mustard reactor. Lieutenant R. Penfield had general supervision of the design and construction work. Dr. Charles S. Venable (later Captain) was loaned by the American University to personally interpret the results on mustard production obtained on a laboratory scale in Washington. In a similar manner, Dr. F. K. Bezzenberger (later Captain) aided in the ethylene investigation.

The quick assembly of the materials required for plant and laboratory was only made possible through the generous co-operation of various Cleveland manufacturing concerns. The attitude of these concerns toward the Development Division throughout the course of the war was, "If we have it, come and get it; if we haven't it, we will get it for you."

On April 2, 1918, the first run was made on the ethylene generator, and on April 26th Lieutenant Marshall with his "crew" started using this ethylene to make mustard. These operations will be discussed in more detail later.

The personnel at this post was increased as the work expanded, the men being as a rule obtained from the different cantonments, where selection was made according to qualifications as registered on the service cards of the men. The following table gives the average number present at the post during each month from April, 1918 to February, 1919:

March, 1918, 35; April, 1918, 50; May, 1918, 70; June, 1918, 80; July, 1918, 85; August, 1918, 160; September, 1918, 145; October, 1918, 140; November, 1918, 156; December, 1918, 55; and January, 1919, 25.

Transfers were constantly being made to Willoughby, Nela Park and Edgewood, a total of 293 men actually being enrolled at the post.

To assist Captain Wright, the first commanding officer, Sergeant G. M. Rollason, was appointed assistant technical director. Sergeant Rollason was commissioned Captain in July, and sent abroad on liaison work. On August 1st, Captain Wright was transferred to Headquarters and Major L. J. Willien was placed in command, as superintendent, with Captain F. K. Bezzenberger acting as assistant superintendent. This arrangement continued until January, 1919, when the station was abandoned. The staff on November 1st was as follows:

Major L. J. Willien, Commanding Officer; Captain F. K. Bezzenberger, Captain J. F. Brewster, Captain J. R. Silver, Jr., Captain C. S. Venable, First Lieutenant W. M. Eaton, Second Lieutenant Howard Sotzen (see page 53), Second Lieutenant R. A. Wilkins; Civilian—Mr. William Green.

Since this plant was producing mustard only in quantities sufficient for experimental purposes, it was necessary continuously to transmit the results obtained to the Edgewood Arsenal, the Hastings-on-Hudson plant, the National Aniline and Chemical Company plant at Buffalo, and the Dow Chemical Company at Midland, Michigan, where mustard was to be made. During the operation of the Cleveland plant, investigations were also begun on the development of superpalite and magnesium arsenide, but both of these investigations were stopped by the War Department before final development stages were attained. When the armistice was signed, the entire plant was being turned over to the development of the production of another gas. The main result attained by the Offense Section, therefore, was the development of mustard gas.

The fundamental reaction involved in the production of mustard gas is that taking place between ethylene gas and sulphur monochloride. Sulphur monochloride was found available on the market in large quantities. The development problem, therefore, was concerned with (1) The commercial production of ethylene; (2) the development of suitable apparatus and plant procedure for absorption of this ethylene gas in sulphur monochloride; (3) the purification, if found necessary, of the product.

As regards the production of ethylene, the process as finally evolved consisted essentially of introducing mixtures of alcohol vapor and steam, in the ratio of one to one by weight, into an eight-inch iron tube with a three-inch core, in contact with clay at 500° to 600° C. The gaseous products were removed through a water-cooled surface condenser. The generator tube was provided with a double system of cock valves, by which the catalyst in the tube could be replaced in a semi-continuous fashion. The accompanying perspective drawing shows the complete ethylene installation.

The introduction of steam along with the alcohol represents a distinct development accomplished by this laboratory, the steam rendering temperature control more uniform and accordingly giving a single unit greater capacity of a higher grade product. The tests on this unit were completed in the early part of May, 1918, the furnace having a demonstrated capacity of 400 cubic feet per hour of ethylene of between 92% and 95% purity, with a conversion efficiency (alcohol to ethylene) of about 85%. Forty units of this type, an installation capable of producing in twenty-four hours sufficient ethylene to make forty tons of mustard, were assembled and sent to Edgewood, where they were operated successfully until after the signing of the armistice. As the prototype of the ethylene generators at Edgewood, the Cleveland unit, therefore, fully justified itself and no vertical kaolin generator has, up to this writing, been used on a commercial scale which has bettered the results obtained by this type of generator.

Five gasometers of a combined capacity of 800 cu. ft. were installed behind the plant for ethylene storage. These tanks were never empty from April 2nd to November 11, 1918.

The 60° C. procedure first used in the production of mustard gas consisted essentially in introducing dry ethylene gas into sulphur monochloride until further absorption ceases. Rapid agitation of the liquid is essential; the reaction is exothermic; and the reaction temperature must be kept between 55° C. and 60° C. The rate of absorption was found to increase with the concentration of mustard produced. The reaction should produce one molecule dichlorethyl sulphide plus one molecule free sulphur per molecule monochloride used. Under the above conditions, about one-half this sulphur reacted with the dichlorethyl sulphide to give polysulphides soluble in the mustard liquor. The remaining half of this sulphur, amounting to about 8% by weight of the crude product, separated out on standing, or separated out immediately if the product was treated with moist ammonia gas. The clear supernatant liquor was to be sent to the shell-filling plants.

The attempt, on April 26th, 1918, at the first semi-plant-scale operation, was exciting but was not a complete success. About fifty pounds of good mustard were produced but the reactor proved to have insufficient cooling capacity to warrant its further use. Accordingly a second reactor of the standard nitrator type, equipped for mechanical agitation, was constructed and successfully operated. This reactor had a capacity of seventy-five pounds of product. A filtros plug reactor, designed at the American University and having a capacity of 350 pounds of product, was also operated at this laboratory.

As a result of these investigations, four one-ton reactors of the mechanically agitated type were designed, assembled and sent to Edgewood where they were later operated by the Edgewood staff.

On June 1st, Lieutenant Marshall and a number of his men were transferred to Edgewood to assist in the production of mustard gas at that station.

MEDICAL AND SURGICAL CARE

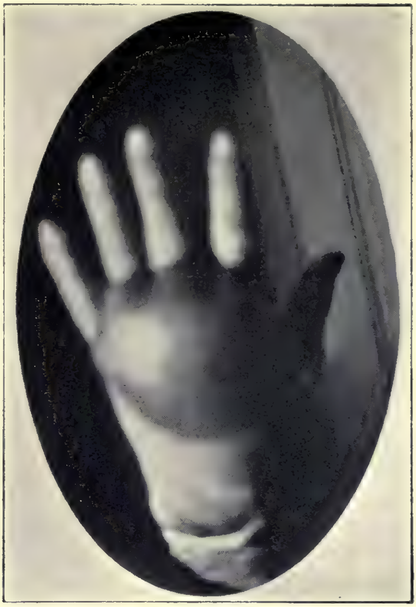
Every care was taken to preserve the health of the men. About the middle of April, a room in the main office was set apart as a dispensary, and on May 1st Dr. M. J. Brickman of Cleveland was appointed contract surgeon and took charge of all the medical work at this post. At the time of his appointment, Dr. Brickman arranged with Dr. Wm. G. Zantiny to assist with the work, each visiting the laboratory on alternate days. Such an arrangement continued until August 27, 1918, when Dr. Zantiny was employed as contract surgeon for the Defense Laboratory, Nela Park. Assisting these doctors, Sergeants L. D. Emery and Clarence A. Elden tied up fingers, anointed burns, and ministered as necessary to the needs of those suffering minor injuries.

The general health of the men was exceptionally good, except for those affected with mustard gas and the epidemic of influenza. One serious accident only is on record, that of Private Julius M. Blum, who was killed in an automobile accident. Much bronchitis and conjunctivitis resulted from exposure to the low concentrations of mustard gas usually found in the mustard rooms, but few lasting or serious effects have been noted. Erythema or rash resulting from this situation also gave no serious results, but the effect was irritating and uncomfortable. The larger number of casualties was due to skin burns obtained from actual contact with the liquid. For the treatment of the most serious of these cases, by authority of an order from the Medical Department, Chemical Warfare Service, arrangements were made with the U. S. Marine Hospital by which a majority of such cases were treated at this hospital.

In connection with the mustard burns, it may be interesting to give a few statistics. Of the 293 men employed at the East 131st Street station, 183 in the course of their work might have possibly come in contact with mustard gas; 92 men, or 50% of those exposed, were burned; 31 men, or 33% of those burned, were treated in the hospital. In at least three cases, the man was in the hospital for three months. The accompanying photograph shows a case of a bad hand burn.

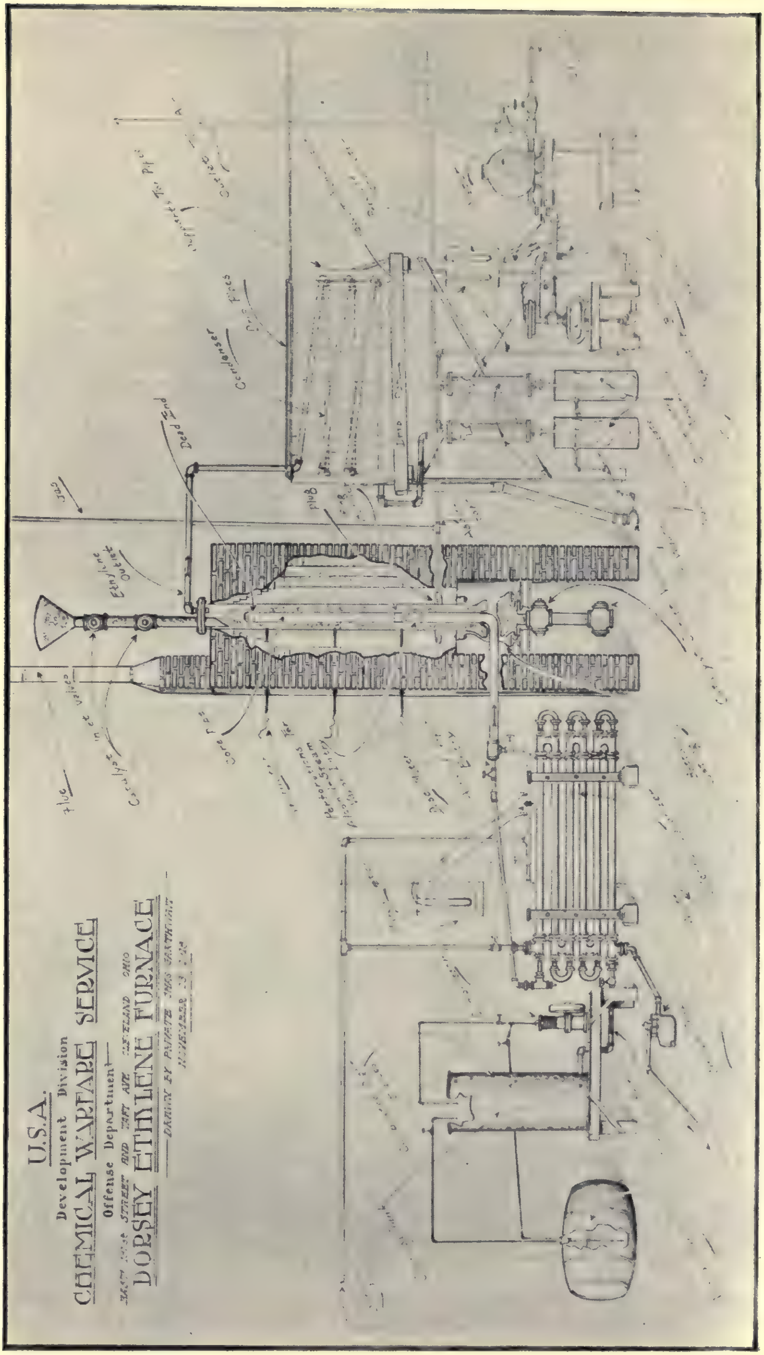
PURIFYING THE "MUSTARD"

With regard to the purification of the product, until the information came through on the 30° C. procedure, the 60° C. procedure had been accepted in this country as most suitable. The problem of sulphur precipitation



Upper Photo—A Bad Hand Burn Caused by Accidental Contact with Mustard Gas.

Lower Photo—The Control and Research Laboratory of the Offense Section, Development Division.


U.S.A.
Development Division
CHEMICAL WARFARE SERVICE
Offense Department
DORSEY ETHYLENE FURNACE
Flue
Catalyst
Inlet valves
Ethylene Outlet
Dead End
Condenser
Drip Pipes
Plug
Core Pipe
Perforations for Steam

The Dorsey Ethylene Furnace, which was used for Large-Scale Production of Ethylene was the greatest bar to its success from an operating point of view and also from the point of view of the shell-filling plants. In addition, it was desired to fill the shell with material as nearly 100% dichlorethyl sulphide as possible. For these reasons, experiments were undertaken, very shortly after the establishment of a successful absorber, on the purification of the crude material. Here again the line of investigation was a duplicate of laboratory procedure—in this case a vacuum distillation.

Two more rooms were partitioned off for this work. In the first room, under the direction of Mr. William Green of the Bureau of Mines, experimental work was performed on an enamel-lined pot still, aluminum flash still, iron flash still, and distillation by means of air at atmospheric pressure in a lead-lined dephlegmating column. In the second room, under the direction of Captain Silver, experimental work was performed on the iron flash still. The result of all this work led to the adoption of the iron flash still as being the most satisfactory.

The still consisted essentially of a set of parallel steam-jacketed iron pipes two inches in diameter and ten feet long, inclined at an angle of 30° with the horizontal. Crude mustard flowing down this tube was vaporized; the vapors entered an upright steam-jacketed foaming chamber, and thence were drawn over into a condenser. The residue dropped from the bottom of the foaming chamber into a suitable container. The whole system was kept under an absolute pressure of about one inch of mercury.

The capacity of this still was demonstrated to be about one ton condensate per tube per 24 hours, the condensate being 92% to 94% mustard, and approximately a 5% loss of the mustard in the original crude was suffered in the process.

Due to the development of the 30° C. or "British" procedure, where a product was obtained in which the sulphur is held in solution and accordingly presents but slight operating and shell-filling difficulties, the method of purification by the flash still procedure was never put into practice at any of the large-scale plants.

This distillation work proved to be the most hazardous of all the work in connection with mustard gas. It was necessary to deal with mustard at temperatures about 100° C.; the apparatus was complicated, and numerous changes in the various experimental installations required the handling of contaminated parts. Accordingly, many casualties were incurred among the personnel involved.

During the latter part of August, the plant was engaged chiefly in work connected with the purification of mustard. The only procedure then in use (60° C. procedure) had by this time been fully developed and placed in operation at Edgewood. Although the Offense Section was experimenting with an installation for the continuous preparation of mustard by this procedure, it was not felt that this installation would prove to be practical. This feeling was later justified.

At this time the information came through from the British on the 30° C., or so-called Levinstein procedure, then in actual practice in England. The British scheme involved the use of coke impregnated with phosphoric acid as a catalyst in the production of ethylene and 30° C. reaction temperature in the production of mustard. The Offense Section immediately transferred the major part of its activities to an investigation of the British procedure.

Captain Bezzenberger was placed in charge of the phase of this investigation dealing with the production of ethylene, his chief assistants being Sergeant J. A. Kelley, Sergeant T. P. Kelly, and Corporal A. H. Hirschauer. Pots and drying ovens were installed and several tons of impregnated coke were prepared. The procedure using this catalyst was practically the same as that in which kaolin was used, with the exceptions that none of the steam was introduced with alcohol, and that the temperature required was 350° C. in place of 500° C.

Attempts to use the new catalyst in the Dorsey furnaces failed. After numerous experiments, a furnace was designed and built that was capable of giving 2000 cubic feet per hour of ethylene 98% to 99% pure. Inasmuch as the kaolin type installation at Edgewood had proved satisfactory, no large-scale application of the phosphoric coke procedure for manufacturing ethylene was made at any of the American plants.

Captain Venable had general supervision over that phase of the investigation dealing with the production of mustard gas. His chief assistants were Sergeant G. H. Porter and Mr. C. H. Bollinger.

The 30° C. procedure consisted essentially in bringing together sulphur monochloride and very pure ethylene gas, in the presence of crude mustard liquor as a solvent, at a temperature ranging between 30° C. and 35° C. A supply of un-reacted monochloride was constantly maintained in the reacting liquid until a sufficient sized batch was built up. Then the monochloride feed was discontinued and the ethylene feed continued until further absorption ceases.

The great advantage of this procedure lies in the complete sulphur "hold-up" obtained when the reaction takes place at 30° C. Apparently the sulphur remains in colloidal solution. By controlling the ratio of uncombined monochloride to mustard according to a predetermined schedule, the reaction velocity is so increased that the lower temperature may be used. The obvious disadvantage is the refrigeration required.

A satisfactory operating procedure was worked out in every detail and the information, as fast as evolved, transmitted to Edgewood, where plant units were in process of installation. The 30° C. procedure was being universally adopted when the armistice was signed.

By the latter part of October, 1918, the work on mustard was finished and the entire plant and laboratory were being switched over to the development of a new gas. Before this work was well under way, the news came of the signing of the armistice. On November 12th, the order was issued to dismantle the whole plant and discharge the men as rapidly as convenient.

INFLUENZA'S TOLL IN THE OFFENSE SECTION

The week following the celebration of the signing of the armistice, the influenza epidemic became prevalent again. During the first wave of this epidemic, beginning October 5, 1918, 15% of the men had contracted the disease. However, no pneumonia had developed and no deaths had been recorded. The second wave, however, gave much more serious results. 33% of the men were affected, 13 cases of pneumonia developed, and nine deaths resulted. An order had been issued from Nela Park directing that all cases of influenza requiring hospital attention be sent to Mt. Sinai, St. Luke's, Charity, and City Hospitals, each of which had offered to take care of nine men. Thanks are particularly due to each individual hospital for the care and attention given to our men during this period. The names of those who succumbed to the disease are here recorded:

HONOR ROLL OF OFFENSE SECTION

First Lieutenant W. M. Eaton.
Second Lieutenant G. L. Royce.
Sergeant C. C. Ringler.
Corporal Yaro Klepel.
Private D. V. Kelly.
Private C. H. Tudor.
Private S. H. Rine.
Private C. W. Van Houten.
Private F. Korrumpf.

These men died in the performance of their duty as soldiers in the army of the United States. We honor their memory.

From the period November 13, 1918, to February 1, 1919, the plant was in process of being dismantled. All apparatus was taken down. This apparatus, together with supplies and material on hand, was later shipped to Willoughby. The men, as fast as they could be spared, received their discharges. On March 1st, all were gone and the plant was returned to its original owners in pretty much the same condition in which it was received March 12, 1918.

MIDLAND SECTION, DEVELOPMENT DIVISION

On February 27, 1918, a station of the Bureau of Mines was established at the plant of the Dow Chemical Company, Midland, Michigan, for the purpose of developing a process for the manufacture of mustard gas. The Dow plant is one of the largest plants in the United States manufacturing chemicals only. The brine wells at Midland run unusually high in bromine constituents, and accordingly the activities of the plant are chiefly concerned with the production of chemicals involving bromine and chlorine. For instance, the plant produces large quantities of sulphur chloride, one of the raw materials used in the manufacture of mustard gas. Mr. Herbert Dow, President of the Dow Chemical Company, generously offered the facilities of the plant in furthering the manufacture of mustard. Dr. A. W. Smith, of the Bureau of Mines, directed the work at this station. In addition, the technical staff of the company showed a willing spirit of co-operation. Mr. Thomas Griswold, Jr., Chief Mechanical Engineer, and Mr. E. O. Barstow, Chief Chemical Engineer, in particular rendered material aid throughout the course of the work.

The initial work at Midland, mainly laboratory experimentation, was carried out by Dr. Smith with the assistance of Mr. Ivan Harlowe, Mr. C. G. Smith, and several other men loaned by the Dow Chemical Company. In early March, 1918, the Bureau of Mines, in answer to a call for assistants, sent the following men to aid in this work: W. D. Van Arnam and Edward Hobson, both later commissioned second lieutenants, C. W. S., Messrs. Kinzie and Max Y. Seaton. On May 15th, Lieut. Wadsworth arrived with a detachment of enlisted men transferred from Hastings-on-Hudson. On May 20th, enough additional enlisted men were received through American University to bring the total Midland enlisted personnel up to twenty-five.

Midland was only a small town, and at that time was very crowded due to the wartime activities of the Dow plant. Upon the arrival of the soldiers, a house-to-house canvass was made in the search for rooms. Through the courteous response of the people of the town, a lodging for each soldier was provided. For their meals, the soldiers ran their own canteen in the parish-house of the Episcopal church. A rest room, equipped with victrola, books, periodicals, etc., was provided for the men by the Dow Company and the citizens of the town.

The new arrivals lost little time in getting on the job. A number of them, especially the Hastings detachment, were already slightly familiar with mustard. The rest were quickly initiated under the tutelage of the more experienced Dow Company and Bureau of Mines operators. Large-scale construction and experimentation were just beginning and there was room for all. They worked hard, did those men at Midland. They felt more or less isolated from the rest of the world, due to the location of the town, but they also felt the importance of their task, an importance measured by the need for mustard and the really wonderful facilities available at the Dow plant for the production of this, the "king of war gases." Their work was hazardous and many were injured, but the complaints were few.

Two serious accidents were experienced among the enlisted men. On May 30th, Private Linn suffered a fracture of the skull when struck by a falling timber. He was sent to the Mercy Hospital, Bay City, and subsequently furloughed home. On June 26th, a much more serious accident occurred. A leak developed in the large "tumble barrel" reactor, which necessitated certain repairs within the tumbler. The seven men engaged in this repair work were severely burned from mustard fumes. The result was fatal for two, Pvt. W. M. Hayward dying July 8th and Pvt. J. H. Speishandler July 22nd. Of the others injured, four of the more serious cases, Pvts. McIntyre, Wickoff, Mendelsohn and Huntoon were carried on July 31st by motor to the Base Hospital, Camp Custer, Michigan.

On May 30th, 1918, Lieut. Wadsworth, the original Commanding Officer at Midland, was transferred to Edgewood. Lieut. Thorp then became Commanding Officer, serving in that capacity until the wartime activities at Midland were discontinued.

In August, as previously mentioned, with the formation of the Chemical Warfare Service, the Midland station became the Midland Section of the Development Division, with Colonel Dorsey as Chief. The actual supervision of the work, however, was maintained by Dr. Smith. Under this arrangement the work at Midland proceeded, and by August 20th an entire plant for the production of mustard had been developed and operated successfully on a five-ton-unit plant scale. It had been originally proposed that, should the development work at Midland prove successful, the plant of the Dow Chemical Company should assume actual production on a scale of forty tons per day. However, in August, the War Department ordered the work at Midland discontinued. The enlisted men were transferred August 20th to Cleveland, and by October 1st the investigation of mustard at Midland had ceased.

The experimental work at Midland was mainly concerned with the design and construction of large-scale apparatus for the production of mustard gas, using procedures evolved on a laboratory scale at other stations, comparatively little laboratory research work itself being done at Midland.

At the time the Midland post was established, work was being conducted on a laboratory scale at the American University by which two procedures had been indicated for the production of mustard. The one on which the greatest progress had been accomplished was the so-called "chlorhydrin" procedure. Accordingly, the first work done at the Midland plant was an attempt to develop the chlorhydrin procedure to a point where it could be put on a production basis.

The procedure involves the production of chlorhydrin by the action of ethylene on the chlorine in water solution. The chlorhydrin solution so formed is concentrated, treated with sodium sulphide to produce thiodiglycol, and the thiodiglycol converted to mustard or dichlorethyl sulphide by the action of concentrated hydrochloric acid.

A month or so later, when work at other stations had established the practicability of the monochloride procedure, the inherent advantages of the relatively simple monochloride procedure over the complicated and costly chlorhydrin procedure led the Midland Detachment to center its efforts upon the development of the former. However, due to the extent to which the chlorhydrin procedure had been developed, and to meet the eventuality of having to fall back upon it for the manufacture of mustard, this work was not entirely abandoned. As a result, a chlorhydrin procedure was finally evolved and, as operated on a semi-large-scale basis, gave decided promise. Several improvements suggested were never put into effect, and on the whole the investigation must at best be considered as incomplete.

Of the two sulphur monochloride processes finally used for the production of mustard in this country, the first, or the 60° C. procedure, was the only one investigated at Midland. The fundamental reaction involved in the production of mustard by this procedure, is that taking place between ethylene gas and sulphur monochloride. Sulphur monochloride was already available in large quantities at the Dow Plant. The commercial problem, therefore, was concerned with

(1) Commercial production of ethylene;
(2) Suitable apparatus and plant procedure for absorption of this ethylene gas in sulphur monochloride;
(3) Purification, if found necessary, of the product.

As regards the commercial production of ethylene, all the experimental generators installed at the Dow plant entailed the same principle, i. e., the dehydration of ethyl alcohol by the catalytic action of kaolin at a temperature ranging from 450° C. to 575° C. In connection with the mustard program intended for the plant, the installation desired was one capable of producing 400,000 cubic feet ethylene per day. Ease of operation and a maximum efficiency as regards the conversion of alcohol to ethylene were essential. Among the earlier generators tried were the electric furnace, rotary kiln generator, Dorsey furnace, and the multiple tube furnace. This earlier work was largely directed by Mr. Harlowe and Mr. Smith.

The final installation was designed and operated by Mr. Morrison of the Dow Chemical Company and was known as the Morrison Generator. This generator used iron boxes 6½ feet long by 5 feet high by 2½ inches wide, as kaolin containers. Sixteen of these boxes were arranged in a suitable furnace fired with oil burners. The capacity of such a generator was demonstrated to be 8000 cubic feet per hour, of ethylene of an average purity of 94%, with alcohol-to-ethylene conversion of 92%.

The kaolin gradually loses its value as a catalyst because of the deposition of carbon resulting from the decomposition of alcohol. It was found that this carbon could be removed by oxidation and the activity of the catalyst restored. The most successful furnace used for clay regeneration was of the oil-fired reverberatory type. This furnace had a capacity of 1000 to 1500 pounds of clay, the time required per charge being five to seven hours. Heating beyond an orange-red temperature was likely to produce vitrification which rendered the catalyst useless.

Ethylene as prepared in any of the standard furnaces contains small amounts of hydrogen, carbon monoxide, carbon dioxide, and the vapors of water, alcohol, and ether. The three gases mentioned are not present to a harmful degree in the gases from a properly operating generator. Water, alcohol, and ether, the first two of which are always present in the gas coming from the condenser, have a very harmful effect upon the mustard produced, and must be removed from the ethylene.

It was found that scrubbing the ethylene with water removed the ether and alcohol satisfactorily. To reduce the per cent water vapor present, the scrubbing tower was cooled below 4° C. The ethylene so purified was successfully used in the experimental-plant-scale production of mustard gas.

For the reaction between ethylene and sulphur monochloride to produce mustard, a type of reactor known as the "tumble barrel" was developed. In the preliminary phase of this work, a reactor capable of yielding about 300 pounds of product was used for experimentation. With this apparatus Lieut. Van Arnam and Lieut. Hobson were able to determine the fundamental features involved in the operating schedule. On the basis of these experiments, a full-sized commercial unit was built and operated, Lieut. Van Arnam being in charge. This reactor consisted essentially of a steel shell 18 feet long and 4½ feet in diameter, rotating on hollow trunnions in a water bath. The inside of the shell was lined with lead. In order to produce a "tumbling" agitation of the liquid within the reactor, every eleven inches around the circumference a three-inch by two-inch angle-iron was bolted against the lead lining, and then completely covered with lead. Holes were burned through the steel shell every five inches, thus giving excellent contact between the water bath and lead lining. Ethylene gas entered through one trunnion, the effluent passing out through the other.

This reactor was capable of taking a 5000-pound charge of monochloride and, with a sufficient supply of ethylene, the reaction was completed in approximately eight hours. The crude product, having an average melting point of 9.4° C. was heated to a temperature of 90° C. and then withdrawn from the barrel by suction. While hot, all sulphur remained in solution. On cooling, a heavy sulphur deposit took place. The clear layer was drawn off, and the sulphur layer discarded. Up to October 1, 1918, 40 tons of mustard had been made at the Midland plant in this type reactor.

In the production of mustard by the 60° C. reaction, the only one used at Midland, a sticky sulphur precipitate, amounting in weight to about 8% of the total weight of crude, separated on cooling the crude product. Purification of the crude mustard was considered desirable, not only because the purer product was considered to be more effective, but because this sulphur deposition was a source of inconvenience in the storing, handling, and loading in shells, of the mustard.

Vacuum distillation was the only method of purification attempted. Experiments were made with an iron pot still, lead pot still and iron flash still. The iron pot still proved unsatisfactory due to the decomposition of the mustard in contact with the iron under the conditions of the distillation. The lead pot still was abandoned due to mechanical disadvantages and low capacity. The iron flash still gave the greatest promise. However, activities at Midland were discontinued before the operation of this still had reached such a point that definite conclusions could be drawn. C. G. Smith was the "still" man, and practically all the work on mustard purification was done under his direction.

The history of the achievements of the Development Division of the Chemical Warfare Service would be conspicuously incomplete without specific mention of the personal work of Mr. H. H. Dow of the Dow Chemical Company. Mr. Dow never lost sight of an opportunity to add to the personal comforts of the men whether in sickness or in health, and the boys of that Section can look back over a good many pleasant memories connected with Mr. Dow and the various officials of his company.

HONOR ROLL OF MIDLAND SECTION

Private W. M. Hayward. Died July 8, 1918, from mustard gas poisoning.

Private J. H. Speishandler. Died July 22, 1918, from mustard gas poisoning.

It was the heroic devotion of such men as these that spelled defeat for the enemy.

EXPERIMENTAL SECTION, DEVELOPMENT DIVISION

In the middle of July, 1918, as already discussed in preceding pages, the Development Division of the Chemical Warfare Service was faced with the problem of developing the manufacture of a new and deadly poison-gas material known in these records as the G-34. It was further ordered that this division was to be on a production basis by December 1, 1918.

It is the purpose of this account to trace the development of the organization which essayed to carry out these orders, and to describe the work which was performed to this end, prior to the cessation of hostilities on November 11, 1918.

It is not permitted to give here any technical information with regard to the G-34 or its manufacture. In this respect, the account of the Experimental Section will be found to differ from that of any of the other sections of this division.

By July 12th, the preliminary work at the American University had shown that the G-34 could be produced, in laboratory apparatus, by a process consisting of five steps. The work had been really carried somewhat further than that. The first two steps had been tested in small-scale equipment with reasonably satisfactory results, although the equipment was of a makeshift nature and not particularly well adapted for the work.

On the technical side, the problems requiring immediate solution were the design and lay-out of full-scale equipment of adequate size. In addition to this, much laboratory research work remained to be done in order to determine with reasonable precision the chemical and mechanical factors which must be considered in designing the large-scale plant.

The other problems of most pressing nature were

(1) The location of a suitable plant for the work in hand. It was particularly necessary to find a plant already built, since the time limit imposed did not allow for the building of a new plant.

(2) The procurement of raw materials for the manufacture of G-34. Some of these were of an unusual nature and not easily obtained. It was early decided that two of these materials, known as Raw Materials Nos. 1 and 2, must be manufactured in the plant itself, and it was necessary to locate the basic raw materials for their manufacture, as well as to carry out the research and development work necessary for the design and lay-out of manufacturing equipment.

(3) The formation of a technical organization to carry out the work of development and manufacture. The existing technical staff of the Development Division was already fully engaged in work of great importance, and was utterly unable to undertake this new task. The getting together of an entirely new organization, of unusual caliber, was of immediate and pressing importance.

Colonel Dorsey attacked these problems with characteristic directness and lack of ceremony. On July 12th, he had been notified of the new task assigned to him. On July 19th, it was decided to take over the abandoned plant of the Ben Hur Motor Company at Willoughby, Ohio. On July 20th, Major James B. Conant of the Research Division arrived, prepared to undertake the laboratory and research work, and was followed on July 29th by his assistant, Lieutenant Lee I. Smith. On July 20th, Lieutenant-Colonel W. G. Wilcox was put in complete charge of the Willoughby plant—which will hereafter be spoken of as the Experimental Plant—as Superintendent, and Capt. J. K. Moore was detailed as his assistant. On July 26th the plant was occupied by a guard of 25 men from the Offense Laboratory in Cleveland, under Sergeant (later Lieutenant) Royce.

This organization immediately undertook to accomplish the thousand and one things which had to be done before the plant would be ready for even the preliminary work on installing the G-34 equipment. Time was infinitely precious and the usual procedure of getting bids for contract work could not be followed, unless all hope of completing the prescribed program within the scheduled time was to be abandoned. It was absolutely essential that full use be made of such facilities as were immediately available. Where time could be saved by the employment of local contractors, there was no other reasonable course to pursue. Most of this work was done on the time-material basis in order to eliminate all chances of profiteering.

A View of the Experimental Station, Development Division, at Willoughby, Ohio

Another View of the Experimental Station at Willoughby, Ohio

The Hospital at the Experimental Station. Originally Designed as an Officers' Quarters. This building was used as a temporary hospital until a more permanent building could be constructed

The Officers of the Experimental Station, Willoughby, Ohio

The Personnel of the Experimental Station

The Non-Commissioned Officers, Experimental Station

It was difficult to get the work done with the desired rapidity under the conditions which existed at this time, but it was done.

It may be of interest to describe the conditions which existed in the Ben Hur plant when it was taken over. The office building was practically complete as far as partitions, doors, electrical connections, etc., were concerned, but in the plant itself the floor, which was of dirt, had never been graded and was very uneven, with many places that had to be filled to a depth of several feet in order to bring them up to the floor level. There was no sewer system and no water lines. A plumbing system had been installed in the office building but had frozen during the preceding winter and had to be completely removed. Electric wiring had been partially installed but was in a chaotic condition and had to be completely removed before a proper system could be put in place.

There were serious difficulties in the way of employing Cleveland contractors for this work. The village of Willoughby is located approximately eighteen miles from the center of Cleveland, and transportation between the two is not of the best. There were no adequate facilities in Willoughby for feeding and housing any considerable number of workmen. Cleveland contractors, who were approached on the subject, required that they be reimbursed for the cost of transporting their men back and forth, and that an allowance be made for the time consumed in going back and forth, amounting to some three hours a day. This time, of course, would have shortened the working day of the men to a serious degree, to say nothing of the excessive expense.

These difficulties could be avoided to a large extent by the use of a local contractor from Willoughby or Painesville, who employed local mechanics and laborers. These contractors, however, were few in number and, without exception, very busy. Mr. Freshwatters, who finally engaged for the grading, laying of sewers and concrete work, was at that time doing an extensive job of paving in the village of Willoughby. A personal appeal to Mayor Carmichael induced the village of Willoughby to waive all claims to Mr. Freshwatters' services until his work at the Experimental Plant should be completed. By similar methods, three other local contractors were obtained for the carpentry and plumbing at the plant, the work on which they were already engaged being postponed in order that the needs of the Experimental Plant might be satisfied as promptly as possible. The attitude of the contractors, and of those who had previously engaged them, left nothing to be desired, and it was only through their co-operation that the necessary work could be done.

Lieutenant Richard Penfield was assigned to assist Lieutenant-Colonel Wilcox in supervising the construction of contract work. By August 1st, a few desks and chairs had been obtained and telephones were being installed; draftsmen were hard at work at hastily-procured drafting tables; a trenching machine was tearing up the dirt floor of the plant; sewer and water lines were being laid; concrete floors were being poured; a gang of carpenters was busy in one corner of the plant building the laboratory, plans for which had been drawn up under Major Conant's supervision; the laboratory equipment, ordered by Lieutenant Smith, was beginning to come in; much of the material and equipment for the initial small-scale factory experimental units had been ordered, and some of it was on the grounds; part of the equipment for large-scale operation had been placed on order. It is interesting to note that, in order to save time, the first of the laboratory equipment was brought in under special convoy, in trunks, as personal baggage.

From a technical viewpoint, the laboratory was of first importance. Work on its construction was begun July 28th and was finished August 11th. By August 12th the laboratory equipment had been installed, an organization had been formed under Major Conant's direction, and research work was started.

Work had been started by Captain H. M. St. John on the design, layout and construction of experimental units for the absorption and distillation processes, based on such laboratory results as were then available and on the previous experiences of Major Conant with the small-scale unit at American University.

On August 7th, Captain R. C. Folger reported and took up his duties as Mechanical Superintendent of the Experimental Plant. All construction, operation, and maintenance of mechanical equipment was assigned to him, while Lieutenant Penfield continued to spend a portion of his time at the plant and supervised the work of designing and ordering the special equipment for full-scale operation. The construction was at first attended with great difficulty, as the number of competent mechanics among the enlisted men was entirely insufficient and the officers detailed to assist with the construction were overburdened with other work. This condition was alleviated somewhat on August 18th, by the arrival of Lieutenant King and several excellent mechanics transferred to Willoughby from the Offense Laboratory in Cleveland. From this time on, as Captain Folger was able to build up a competent organization, the construction work gathered momentum, and by September 1st was proceeding in a very satisfactory manner.

The procurement of materials for the manifold activities of the plant was carried on under peculiar handicaps. Lieutenant Gracey, as Procurement Officer, began on July 23rd the onerous task of getting together in record time the vast miscellany of equipment and materials for which the other officers of the plant were pressing him. Without a railroad siding, without motor trucks except such commercial vehicles as could be hired by the day, almost without an office force or assistants of any kind, with wholly inadequate telephone and telegraph facilities, Lieutenant Gracey probably put in longer hours than any other man on the job. As time went on, these handicaps were, of course, removed one by one, but at no time did the sorely harassed Procurement Officer fail to obtain, by one method or another, the required materials.

One serious cause of delay in the progress of the work resulted from the unsatisfactory living conditions at the plant. The only available quarters for the men were the two squad rooms on the ground floor of the office building, which soon became seriously overcrowded. Although the first steps to provide barracks and mess halls for the men were taken in late July, it was not until early October that this condition was remedied. Meanwhile, the officers lived in tents on the grounds, and the men occupied the inadequate and inconvenient squad rooms. It was necessary for both officers and men to take their meals at a restaurant more than half a mile distant, and much time was lost in going back and forth, particularly when the increased numbers of the enlisted personnel made it necessary for them to take their meals in relays. An impromptu noon mess for the officers, instituted by Lieutenant Smith about the middle of August, was of considerable help, but loss of time from this source continued to be a serious factor until the first mess halls were opened.

On August 3rd, Captain G. A. Plummer and Lieutenant Michael Wolfe, of the Medical Corps, reported at Willoughby. Ten enlisted men of the Medical Corps had already arrived. Steps were immediately taken to order medical supplies and equipment, and the work of caring for sanitary conditions and conducting physical examinations of the enlisted men was instituted. By the advice of Colonel Lyster, it was decided to transform the proposed Officers' Quarters into a temporary hospital, to be used until a more adequate hospital could be constructed and equipped. Plans for such a hospital were at once drawn up.

It was realized at the very beginning that the work to be carried on at the Experimental Plant must be surrounded by the utmost possible secrecy. Not only was it forbidden to divulge in the slightest degree the nature of the product to be manufactured, but officers and men alike were bound not to disclose the location or even the very existence of the plant. Both incoming and outgoing mail of the enlisted personnel was censored. A Cleveland address (Lock Drawer 426) was used, and no one was permitted to mention the name of Willoughby in correspondence or conversation with outsiders, under penalty of court martial and severe punishment. Letters could not be mailed through the Willoughby Post Office, nor could telegrams be sent or received except through Headquarters at Nela Park. An early effort was made to have installed a direct telephone connection to one of the Cleveland exchanges and another direct wire to Headquarters, but this failed of accomplishment for more than a month, during which time the enforced use of the Willoughby telephone system nullified, to some extent, the attempt to keep secret the location of the plant, particularly with respect to the City of Cleveland.

For the first couple of weeks the enlisted men at the plant were not permitted to leave the grounds, except for the purpose of taking meals, to and from which they marched in formation in charge of a sergeant. This restriction was, however, modified on August 10th, as the result of an order of Major-General Sibert, who visited the plant on that date.

After a talk to the assembled men, and receiving from them an enthusiastic pledge of their loyalty and co-operation, General Sibert ruled that the Experimental Plant should be governed as a regular Army Post, and that short-time passes might be issued for visits to the Village of Willoughby, and occasionally to Willoughbeach. The City of Cleveland remained forbidden territory and the men were warned to guard their tongues carefully at all times and were pledged to report immediately all cases of violations of the secrecy rules which might come to their attention. To the credit of the Experimental Plant personnel, be it said that General Sibert never had any occasion to regret his wise and generous confidence in the loyalty and discretion of the men.

At the very best, the daily life of the men was monotonous and almost bare of recreation. Work in the plant was hard, and at times dangerous. Furthermore, the regular routine of a military post in time of war had to be observed. Toward the rectification of this condition, a very real and patriotic service was performed by the local Red Cross. Special mention should also be made of the work of Mayor and Mrs. Carmichael and of Mr. and Mrs. H. S. Stebbins. Through their combined efforts, the men were supplied with books, periodicals, and music, the latter in the form of a phonograph and a grand piano. Every day quantities of fresh fruits were left at the plant, while on several occasions there were large donations of ice cream and of home-baked pies and cakes. Another much-appreciated gift was that of a bathing suit for each enlisted man at that time on duty at the plant. The Village of Willoughby certainly did its bit during those hot and trying days of August.

During the month of August all branches of the work progressed with constantly accelerating velocity. The officers of the post virtually lived with their work, seven days a week, from that early hour of six when they were awakened by Major Conant's musical "A-a-all up," until ten or twelve at night when they sought refuge in their tents without a thought or feeling left except a positive hunger for sleep. The technical progress of the work was guided by many conferences, both formal and informal. In fact, every gathering of two or three officers invariably resulted in an animated—and sometimes almost acrimonious—discussion of some vital phase of the work. Activities of the outside world were almost forgotten except for such activities in France as necessitated a daily re-adjustment of the pins on the big war map in Captain Cowan's office. A less complete concentration on the problem could hardly have accomplished the results actually attained during these first strenuous days.

Really phenomenal progress was made in the laboratory research work under the inspiration of Major Conant's energetic supervision. As a result of this work, revolutionary changes had to be made in some of the processes as originally planned for the manufacture of G-34. These matters were discussed and decided in frequent conferences presided over by Lieutenant-Colonel Wilcox and sometimes participated in by Captain McAdams, Colonel Dorsey's executive assistant. Captain McAdams also played a prominent part in connection with many other details of administration.

In view of the fact that Major Conant and his detachment were to return to the American University, it was necessary to obtain a man to replace him and take charge of all laboratory work, both research and routine. Captain M. M. Harrison was obtained in September for this purpose, and, in addition to becoming familiar with Major Conant's work, made several important improvements in the laboratory analytical methods.

Throughout August and much of September, Captain Folger's men worked long hours on the construction of the experimental factory units. Consummation of the production program as outlined was dependent upon a prompt placing of the orders for large-scale equipment, but this equipment could not be intelligently designed and ordered until the experimental units had been operating long enough to make possible a thorough study of the processes involved, on something larger than a merely laboratory scale.

The construction of the experimental units for the first and second steps was not really begun until August 17th, having been delayed until the civilians employed by the various contractors should have left the plant.

On August 30th, these units were complete and the first run was made by Sergeant Olson. The results were entirely satisfactory except for certain minor mechanical difficulties which could easily be removed. The apparatus was under excellent control and the intermediate material made compared favorably with that produced in the laboratory. These units operated intermittently without any considerable change in construction through the months of September and October. As a result of the operating data thus obtained, such equipment as had not already been ordered for the large units was ordered early in September, and the plant layout for these units was completed by Lieutenant Penfield.

Construction work on the experimental unit for making Raw Material No. 2 was begun on August 22nd and completed on September 8th. Satisfactory experimental operation began almost immediately, under the direction of Lieutenant Reichert. It was found by trial in the small-scale unit for the first step, that this raw material made in the experimental unit was of excellent quality, more suited to the work, in fact, than that previously obtained from other sources. The full-scale apparatus for making this raw material called for ten 1300-gallon cast-iron stills, provided with stirrers. The manufacturing concerns who normally had such equipment were unable to take this order. The Buffalo Foundry and Machine Company loaned drawings and specifications from which it was possible to have these stills cast and machined by Cleveland concerns.

By August 26th, laboratory research work on the manufacture of Raw Material No. 1 had progressed to such a point that factory experimentation could be started. One or two full-size units had already been ordered and delivered. One unit was ready for operation on September 10th, when the initial run was made. Serious difficulties of operation were encountered at first, but after a few unsuccessful runs, the unit began turning out a very high quality of product, better than could be purchased in quantity on the open market, and this material when tested in the experimental unit for making the first intermediate proved to be entirely satisfactory.

Additional units were installed until, by October 20th, four units were operating regularly. By this time, operating methods had been improved to such an extent that the production rate was more than double its first value, a plant layout had been decided upon, and equipment had been ordered for the total number of units planned.

No difficulty was encountered in the third step as operated in both the small and full-scale units. The necessary equipment for the full-scale units was manufactured in Cleveland.

Reference has already been made to the fact that the results of laboratory research work had indicated the necessity of certain changes in the fourth and fifth steps of the process.

The complete experimental equipment for these processes had been ordered and delivered, and construction work had commenced about August 25th. In a conference held on August 28th, it was decided that the fourth step, as originally planned, was impracticable on a large scale, and that its place should be taken by a different process. The fifth step was also modified in order to decrease the danger of explosions and at the same time obtain a form of apparatus more easily procurable. The necessary equipment for this change was ordered on September 5th and construction work proceeded under pressure.

By September 20th, the apparatus for the revised fourth and fifth steps was complete and the first runs were made under the direction of Lieutenant Punnett. The results obtained proved that these revised methods of manufacture were entirely practicable and it was felt certain that they could be carried out successfully on a large scale. Full-size equipment for the complete plant was immediately ordered, although the time of operation of the experimental equipment had been too brief to permit a complete analysis of all of the factors involved, and much of the data necessary for design had to be obtained by estimation. It was, of course, fully realized that this was not the most desirable procedure, but so many changes of plans had been necessary that there was no longer time to wait for more complete experimental results, particularly as the wartime conditions prevailing in the industries made it impossible to get prompt deliveries, even on War Department orders.

This completes the record of the factory research work at the Experimental Plant. Further experimental work was carried on in order to verify conclusions previously based on somewhat meager data, but from this time on, the greater part of the energies of the entire organization were concentrated on the layout and construction of the full-size plant equipment.

Throughout the period so far covered, much time and thought had been expended on methods for insuring the safety of the men engaged in the manufacturing work, which was admittedly hazardous in the extreme. On August 25th, a supply of Tissot masks of the latest improved type was received and at once issued to the officers and men. To Lieutenant Smith was entrusted the task of drilling the men in the use of these masks. All members of the post organization were required to have their masks within easy reaching distance at all times. In the experimental units everyone was required to wear his mask in the "alert" position at all times, and actual use of the mask was insisted upon whenever the atmospheric concentration of toxic material became appreciable. Frequent drills were held until the men became proficient in adjusting the masks within the required time limit.

Early in September, Major Young of the Medical Corps, who was stationed at Edgewood Arsenal, came to the Experimental Plant to train the personnel of the post in the most efficient methods of gas defense and to provide for the installing of up-to-date equipment. A number of Klaxon horns and an alarm system with stations at various parts of the plant had already been ordered and partially installed; under Major Young's direction, this system was greatly amplified, and a complete set of rules was drawn up for the guidance of members of the post. The Fire and Gas Brigade, which had already been organized by Lieutenant Smith, was put under the direction of Captain Plummer; a Fire Chief was appointed to direct the activities of this brigade and to make frequent inspection of all protective equipment. Laundry machinery and lockers were ordered, and arrangements made to provide that toxic clothing should never be worn or carried outside the plant proper.

Occasional alarms, sometimes "for cause," sometimes for purpose of drill, soon accustomed everyone to emergency use of the masks, and the

Fire and Gas Brigade rapidly became proficient in the exercise of its duties. All protective measures were handled by the Medical Corps, including the issuance of masks, oilskin suits, gloves, etc.

As these varied activities progressed, there was a constant increase in the personnel of the post, including both officers and men. Among the officers, a number of important additions were made, men who contributed largely to the ultimate successful development of the work at this plant. Due to the number involved, no individual mention of these men will here be made.

It is fitting, however, in this connection to note those men who, due to the signing of the armistice, failed to get the commissions for which they had been recommended—Dr. Shorger, assigned to special research problems, and Dr. A. S. McDaniel, technical director, who were to receive captaincies; Mr. W. L. Winn, in charge of design and construction of the hydrochloric acid plant, who was to receive a first lieutenancy.

The non-commissioned officers who had been recommended but failed of promotion to commissioned grade because of the cessation of hostilities were Battalion Sgt. Major Gunderson, in charge of guard duty and military routine, Sergeants First-Class Albert W. Smith, William T. Little, Duncan M. Dearing and George H. Ruppert of the operating force, and Sergeant First-Class John A. McGivern, who had charge of the mess.

The increase in the number of enlisted men had been rapid. The number originally planned was about 300, but as the operating schedule was increased and the need for many more men became apparent, plans were made to provide for nearly eleven hundred men at the Experimental Plant. On Armistice Day the organization of the post, including Major Conant's detachment, numbered 22 officers and 542 enlisted men.

The apparent shortage was due to the difficulty in procuring men from the various camps where influenza quarantines were in force, though hearty co-operation was received from the Washington Personnel Office.

After much preliminary delay, the building of barracks and mess halls for 500 men, which had been authorized late in August, was begun about the middle of September by the Cleveland Construction Company, under the supervision of Captain Summer of the Construction Quartermaster's Department. Before construction was complete, the program had been extended to provide for 1000 men. The first barracks building and the first mess hall were ready for occupancy early in October, although the construction of the other buildings was not entirely completed until the first of November. It was said that the building of the first four barracks and the first two mess halls was done with a speed which constituted a new record for the Construction Quartermaster's Department. Construction on a 48-bed hospital was begun in the latter part of October and the hospital was occupied about the middle of November.

Other construction work more or less completed by the Cleveland Construction Company included a storage building along the north side of the plant, temporary storage sheds, a transformer house, a garage, and a concrete foundation for a large sulphuric acid tank. This construction was stopped shortly after the signing of the armistice.

Preparation for manufacture on the scale indicated involved a great deal of work, some of which has been very lightly touched upon in these pages. At a conference early in September, at a time when most of the general plans for manufacture had been completed, Lieutenant-Colonel Wilcox stated that if the prescribed production schedule was to be carried out, it was necessary to double the manufacturing installation. This involved very radical changes in the plans already made. Much additional equipment had to be ordered, plans had to be made to provide for approximately double the number of enlisted men previously estimated, and the entire plant layout had to be changed in order to provide room for the additional equipment. It was found necessary to provide a separate building for the manufacture of Raw Material No. 1, outside of the existing plant building; at the same time, plans were made for a shell-filling plant, as it was then considered desirable that this final process be carried out at the Experimental Plant. The ventilating system had to be greatly expanded, as did also the heating system, while the problem of cleansing effluent air from the ventilating system and vent pipes became more serious than ever. The water supply, which had previously seemed adequate, was now seen to be entirely insufficient for the needs of the plant, and arrangements had to be made for treatment of a large part of the water in a cooling tower, so that it could be used over again. For a similar reason, plans made for the procurement of electric power supply had to be entirely revised and a high-tension transmission line, about two miles in length, had to be built. Several additional plots of land, in the neighborhood of the plant, were leased, bringing the total up to about 30 acres. Other details large and small, too numerous to mention, had to receive fresh consideration.

Not the least of the difficulties imposed by this expansion of the program was the procurement of greatly increased quantities of equipment, general supplies, and raw materials of manufacture, at a time when few things of consequence could be obtained without priority orders and other time-consuming negotiations with Washington. Most of the burden of this work fell upon Captains Moore and McAdams, who were compelled to adopt many ingenious expedients in order to meet the requirements imposed by the meagerness of time at their disposal. Fortunately, an adequate trucking service had at last been provided, and two sidings from the New York Central R. R., one on either side of the plant, were completed about the middle of October. It is only just to all of the officers who were concerned with the purchase and procurement of equipment, materials and supplies to say that by November 1st these various commodities were pouring into the plant at a rate which became decidedly embarrassing a few weeks later, when all construction and operating work was suddenly terminated.

By November 1st, all the details for large-scale production were nearing completion. Sufficient Raw Material No. 1 was on hand to begin quantity production. The work on the construction of the large-scale plant for making Raw Material No 2 had been started and could be rushed to completion in a very short time. Large-scale units for the first and second steps of the process were practically complete and production was scheduled to start November 15th.

This completes the history of the Experimental Plant up to November 11th, 1918—Armistice Day. While construction and operating work did not cease instantly on that date, the progressive nature of the work did

Interior view in Barracks at the Experimental Station, showing the excellent condition in which these Barracks were kept

General View of Barracks at the Experimental Station

Interior of Mess Hall at the Experimental Station

become retrogressive with a suddenness that seemed decidedly abrupt to an organization which had been driving ahead at constantly increasing speed. After a brief period of marking time, following the signing of the armistice, the work of dismantling and demobilizing began. Early in December, about 300 were discharged from the service, and several of the officers returned to civil life. The remaining personnel was re-formed into a new organization, which at once began the tedious task of dismantling, inventorying and disposing of equipment and materials.

As soon as the operating and construction work had been halted, the restrictions previously imposed upon the members of the post were relaxed somewhat. The pass privilege was extended to include the City of Cleveland, the mail censorship was discontinued, and all overtime and Sunday work ceased. The Y. M. C. A. established headquarters in one of the mess halls and installed complete equipment for moving pictures, athletic exercises, and a variety of other activities for the entertainment and convenience of the men.

It was about this time that the medical detachment faced its hardest task. The Experimental Plant had suffered very little during the early stages of the influenza epidemic then sweeping the country, but during the latter half of November the new hospital was filled to overflowing. Thanks to the skill of Captain Plummer and his assistants, comparatively few of the cases became serious, and only one death resulted, that of Private Charles C. Herpst, who died on December 7th. This was the only death at the Experimental Plant during the period covered by this history.

SPECIAL INVESTIGATIONS SECTION, DEVELOPMENT DIVISION

INTRODUCTION

The Special Investigations Section was formed on August 10, 1918, and began work at once on the problem of obtaining booster casings for 75-mm. gas shells. On August 17th, the problem of lining the 75-mm. gas shell with glass according to the French practice was assigned. However, it was not until September 14th that General Letter No. 3 from Development Division Headquarters was issued, confirming verbal instructions previously given specifying the function of this section. This letter read as follows:

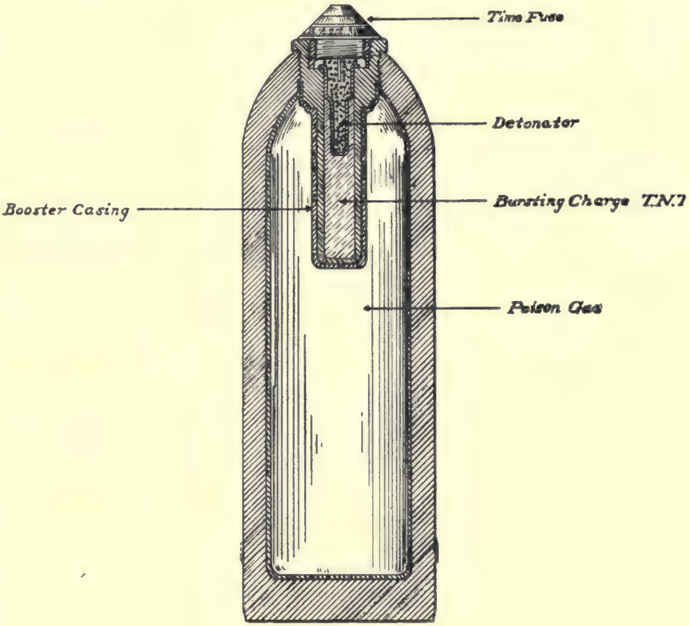
> GENERAL LETTER No. 3 September 14, 1918.
>
> Subject: *Formation of the Special Investigations Section of the Development Division of the Chemical Warfare Service.*
>
> 1. The Special Investigations Section will after about Sept. 23rd be located in the new office building at Nela Park, Cleveland, Ohio. Until these offices are available, the Headquarters of this section will be in Room No. 248 Lamp Development Laboratories Building.
>
> 2. The Special Investigations Section will be in charge of Capt. D. MacRae.
>
> 3. The function of this Section will be as follows:
>
> (a) The following up of experimental work done in other laboratories than those of the Development Division on problems in which we are directly interested.
> (b) Development of processes for the manufacture of articles which can not be done to good advantage in the regular laboratories of the Development Division.
> (c) Carrying on of special investigations in laboratories other than those of the Development Division.
> (d) Investigations of various problems in connection with processes developed and being developed in the various laboratories of the Development Division.
> (e) Handling of all miscellaneous problems which can not to good advantage be handled in the regular laboratories of the Development Division.
>
> (Signed) F. M. DORSEY
> Col. Chem. War. Serv., U. S. A.
> Chief, Development Division.

The Special Investigations Section was only active during the last three months of the war. The main problems actually undertaken were the extensive ones in connection with the production of booster casings and the lining of gas shells. It is natural, from the nature of these problems, that in the time available none of this work was completed. A brief resume of the results attained is as follows:

BOOSTER CASING

On August 8, 1918, the problem of developing a booster casing and adaptor for the 75-mm. gas shell was undertaken by the Development Division at the request of the Director of the Chemical Warfare Service. This work was to be carried out independently of that in progress under the direction of the Ordnance Department.

Methods of manufacturing booster casings by die casting from an aluminum copper alloy, and by machining in one piece from iron castings



CROSS SECTION OF GAS SHELL

or bar stock steel were investigated. At the time of the signing of the armistice, a very promising die-cast booster casing and adaptor with a die-cast lead jacket had been designed and tests on it partially completed. The chief advantage of this arrangement was the rapidity with which it could be produced.

However, the best solution to the booster question was believed to be to machine them in one piece from bar stock steel. An experimental production unit for the manufacture of these booster casings as established at the plant of the U. S. Automatic Company, Amherst, Ohio, had a demonstrated capacity of 2000 per 24-hour day.

GLASS-LINED SHELL

On August 17, 1918, the problem of duplicating the French process of lining gas shells with glass was assigned to the Special Investigations Section. Some experimental work on this problem had been carried out at the Corning Glass Works under the direction of the Research Division of the Chemical Warfare Service. It had been concluded from these experiments that a glass-lined shell, on account of its fragility, was inferior to an enameled or a lead-coated shell.

The experiments at the Corning Glass Works were continued under the direction of this section with the purpose of improving details of manufacture so as to produce a glass lining that would be more resistant to shock. A parallel series of experiments was begun at the Glass Technology Department of the National Lamp Works. More than seven hundred shells were lined at Corning and a lining developed that would withstand a drop of 15 inches on a concrete floor. Out of 125 of these shells shipped to Cleveland, Ohio, from Corning, New York, a distance of 311 miles, only two linings cracked. The seal between the booster casing and the glass lining was so arranged that cracking of the glass would not result in leakage of the gas, but only in contact of the gas with the lining.

At the time of the signing of the armistice, production at the rate of 500 per day could have been attained on a week's notice.

The personnel engaged in this work was as follows:

Capt. Duncan MacRae, in charge of the Special Investigations Section, had general supervision of the preliminary experiments on booster casings and personally directed the work on die-cast booster casings and glass-lined shells.

Capt. L. G. Cover was assigned on August 10, 1918, to the Special Investigations Section to work on booster casings. He continued in this work for about three weeks, when, on account of his acquaintance with manufacturing firms in the Cleveland District, his services in connection with the design and construction of the Headquarters office building and the procurement and installation of equipment for electrical, steam and refrigerating operation at the Experimental Plant, were so urgently required that from Sept. 1, 1918, this work occupied his entire time.

Capt. J. F. Donovan, Manager of the Equipment Development Department of the National Lamp Works, had for some time been acting in a consulting capacity on mechanical problems of the Development Division, and about October 1, 1918, entered the service of the Development Division, giving his entire time to work on the production of a one-piece steel booster casing machined from bar stock, and the establishment of the experimental production unit for the manufacture of steel booster casings at the plant of the U. S. Automatic Company, at Amherst, Ohio.

Sgt. A. W. Nickerson had charge of the office work and property of the Special Investigations Section, and spent a great deal of his time interviewing manufacturers and hastening shipments of material.

Sgt. E. R. Campbell was of great assistance to Capt. Cover in the procurement of engineering equipment for the Experimental Plant, and the construction of the headquarters office.

Master Engineer Charles Garthwait, a private assigned to the Defense Section, showed exceptional ability in making perspective sketches of experimental equipment, and was assigned to the Special Investigations Section so that his work would be available to all the sections of the Development Division.

With the present paragraph, this account of the activities of the Development Division, Chemical Warfare Service, is ended. It is a record upon which everyone who had a part in it may look with pride and satisfaction, for it played a definite part in the winning of the war.

SPECIAL WAR ACTIVITIES OF GLASS TECHNOLOGY DEPARTMENT

In July, 1917, the Glass Technology Department of the National Lamp Works, Mr. W. M. Clark in charge, was consulted in regard to the development of a more satisfactory optical glass. The production of optical glass, before the war, was an almost unknown art in America, the supplies coming from England, France and Germany. The pressing requirements of the army and navy for glass for lenses in range finders, field glasses, periscopes, etc., were brought up in the Council of National Defense in May, 1917.

The initial difficulties in the new art were many. In July, 1917, Dr. Whitney, who as a member of the Naval Consulting Board, was familiar with the government requirements, appealed to Mr. F. S. Terry to have the National do everything in its power to assist the Government in obtaining a supply of high-grade optical glass. This led to journeys to the Bausch & Lomb Optical Company plant at Rochester, N. Y., where interviews were arranged with Dr. A. H. Day and staff of the Geophysical Laboratory at Washington, D. C., who had been detailed to Rochester to supervise the technical developments.

One of the principal problems was to obtain satisfactory clay pots in which to melt the glass. By interesting the Buckeye Clay Pot Company at Toledo, Ohio, who had supplied The National Lamp Works for years, a superior container was obtained and large numbers of these pots were supplied to Bausch & Lomb, the Spencer Lens Company and other optical-glass manufacturers. Speedy production was the all-important point and all efforts were directed towards increasing the quantity and quality of the product of known glasses, no effort being made to develop any new glass.

The Government also had difficulty in obtaining a satisfactory heavy flint glass for airplane camera lenses. This required a purer grade of potash than was being produced in this country in September, 1917. Fortunately, the Glass Technology Department happened to have 3000 pounds of high-grade German potash in stock, imported before the war, and this was immediately delivered to the Government so that they had pure material to work with until the American potash manufacturers had succeeded in improving their quality.

The work done by the Glass Technology Department in connection with gas shells has been mentioned on page 226.

THE WAR STORY OF THE X-RAY AND VACUUM TUBES

The Adaptability of the National Lamp Works to Vacuum Tube Manufacture

No other part of the war work performed by the National Lamp Works was so nearly like its own particular line as that done in connection with the development and manufacture of "vacuum" tubes and "X-Ray" tubes.

In fact, from the standpoint of general construction, these tubes were nothing more nor less than very expensive and highly complicated lamps. To be sure, their purpose was not to give light, but, like lamps, they were made up of glass bulbs containing filaments and had to have the air pumped out of them in a skillful and highly specialized way. It is not at all surprising, therefore, that the Lamp Facilities Laboratory at Nela Park was conspicuously successful in this particular branch of the war work of the National.

Since the vacuum tubes were used principally in wireless telegraphy and wireless telephony, both on the battlefields and in all the work back of the lines requiring a rapid and dependable system of communication, and since all this work came under the direct supervision of the Signal Corps of the U. S. Army, a few explanatory remarks regarding the latter Corps will be in order here.

Why the Signal Corps Had to Have Vacuum Tubes

The transmission of military orders and tidings is a problem of such great importance in warfare that it is handled by a highly specialized branch of the United States Army, known as the Signal Corps. In the war with Germany, the Signal Corps was responsible for the operation of all the methods of communication used in the field and, second, it was in charge of the production of all the equipment employed for this kind of work.

The science of military signalling has been a rapidly-progressing one, really wonderful developments being made while we were engaged in the World War. In the Civil War campaigns, no force could be effective in the field unless it could be reached at all times by pony express riders, runners, or by visual signals. The rapid development of the telegraph and the telephone overcame the difficulty and uncertainty attendant with systems of communication such as these, so that in the World War armies extended over fronts of 125 miles or more, with every division in constant and immediate touch with every other division through the complete and accurate systems of communication in use on the field.

One of the very striking accomplishments of the Signal Corps during the war, and one which will probably have far-reaching results in peace times, was the establishment of an accurate and dependable system of trans-Atlantic radio ("wireless") communication. The allied armies had also developed a complicated system of radio communication in the field, employing radio sets of small power. These were operated from airplanes, were used in connection with ground telegraphy sets in the front lines, and in the field wireless sets used for general communication with headquarters. Probably the greatest field for radio communication was in fire control work for artillery. In the latter months of the war, wireless telephones were being used to a limited extent as a means of communication between airplanes flying in formation.

If one reviews the developments of the two or three years when virtually the whole world was at war, we seem to have lived a century in this brief period. What a far-fetched romantic fairy story the truth of to-day would have seemed to us in our childhood! Men talking across the broad expanse of the Atlantic Ocean without a wire is romantic enough of itself, but what of an ace with his radio set controlling the fleet action of a mighty host of flying battleships engaged in deadly battle miles up in the air?

It seems fanciful, but it is real that to-day we send men up miles above the earth to obtain weather information of distant points, and we have the information telephoned back to us on earth. These are indeed "messages from the ethereal blue."

Without the Vacuum Tube these achievements would have been impossible.

What would Napoleon not have given for just one hour of aerial telephone service to direct the fire of his artillery? Airplanes and mighty dirigible balloons fitted up with wireless telegraph and telephone sets scouring the sea for pirate submarines preying on merchant ships, fighting their enemy with bombs and calling the patrols to destroy their quarry, sounds like a fairy story, but in 1918 it was a grim reality. Airplanes calling on airplanes for assistance when hard pressed in a death struggle in the air was all too real, although it seems like a story only built of fancy.

The series of developments which preceded the practical use of the long-distance wireless telephone and the great advances made in wireless telegraphy *were made possible only by the remarkable improvements made in the quality and construction of the vacuum tubes used in all radio outfits.* The incidents and problems connected with the development of these vacuum tubes, commonly called "kenotrons" or "pliotrons" according to their construction, form what is probably the most fascinating story of technical research work undertaken during the war.

The beginning of the war found the Signal Corps in great need of the vacuum tubes, and it was immediately realized that the tubes would have to be manufactured on a scale hitherto unthought-of. The war requirements of the army and navy necessitated the immediate construction of a large number of radio outfits, from the smallest possible size for airplane work, to the large sizes designed for work in land bases and headquarters and for controlling the movements of a squadron of airplanes flying in formation. Not only was it necessary to produce vacuum tubes in large numbers, but due to the inefficient and short-lived tube which up to this time we had been content to use, it was also necessary to develop a more efficient and a more sensitive tube which would satisfactorily fulfill the requirements demanded by the service overseas.

HOW THE PLIOTRON AND KENOTRON TUBES OPERATE

The vacuum tube, commonly called the pliotron, and mentioned so often in this story, deserves many chapters to cover the fascinating story of its development; particularly the wonderful scientific laws which govern its action and the almost unbelievable amount of work that was accomplished by the Company in supplying the needs of the army and navy with these tubes. The amount of progress that the world owes to these tubes is a source of just pride to all those engaged in the work at the laboratories and lamp factories where so much of the work was done that led to their highly developed state.

To give the reader a better idea of what the vacuum tube is used for, and to state briefly the principle of operation of the tube, it is well to review the developments leading up to the rather unsatisfactory use of the tube at the outbreak of the war early in 1917.

The vacuum tube had its beginning in the "Fleming valve," named after Dr. Fleming of England, who discovered the peculiar action now known as the electron emission phenomenon; that is, if a cold material be placed close to a heated metallic substance or filament, there is a flow of negative electrons from the filament to the colder material. This phenomenon is utilized in the vacuum tube by employing a cold plate, usually of nickel or molybdenum, which is called the "anode," and a hot tungsten filament or "cathode." When this filament is heated in a highly evacuated space, it gives off "electrons"—negative charges of electrical energy. The electrons flow from the hot cathode to the cold anode and, by using the proper instruments, can be measured. The flow is controlled by the temperature of the filament; the higher the temperature, the greater the flow of electrons. This particular type of tube having the two elements, i. e., the plate and the filament, was named the "kenotron" tube ("*keno*," a Greek root, signifying "empty" or "a vacuum").

A "WIRELESS" DETECTOR

This discovery was further improved by Mr. De Forrest, who inserted a third member between the filament and plate, called the grid. It was found that by varying the voltage on the grid it was possible to control the flow of electrons from the cathode to the anode. The peculiar feature of the grid control was that very small changes in grid potential produced very large changes in electron flow. This feature made the tube suitable as a detector and reproducer of very weak wireless signals. It changed, or "amplified," wireless signals of radio frequency into signals of audible frequency. This three-element type of tube having a filament, plate, and grid, was known as the "pliotron" ("*plio*," a Greek root, meaning "amplify"). Hence, pliotron conveys the idea of an instrument capable of amplifying,—that is, of making feeble signals stronger.

Shortly before the entrance of the United States into the war, Dr. Irving Langmuir of the General Electric Company's Research Laboratory at Schenectady, New York, produced vacuum tubes of this three-element type which proved to be the most satisfactory of all the types then in use. In July, 1917, when the Signal Corps and the Navy became particularly interested in wireless communication, it was found that these tubes were being reproduced only in laboratories, and involved very elaborate laboratory processes which did not permit of commercial manufacture.

THE BEGINNING OF THE WORK AT NELA PARK

To meet the requirements of the Government, the Research Laboratory decided to obtain the co-operation of the General Electric Company's Lamp Works and, on August 11, 1917, Mr. Hawkins wrote to Mr. W. R. Burrows of the Edison Lamp Works and to Mr. W. H. Roberts of the National, asking for assistance in the manufacture of small pliotrons. Mr. Hawkins explained the demand of the Government for vacuum tubes, and the representatives of the two Lamp Works expressed their willingness to co-operate with the Research Laboratory in the manufacture of the tubes. They offered such facilities as might, in the opinion of the Research Laboratory, be needed to develop and commercially manufacture the various kinds of tubes.

At a meeting of the Manufacturing Committee of the National Lamp Works, Mr. Roberts informed the committee of the Research Laboratory's request, and at this meeting it was decided that the commercial manufacture of the tubes should be placed in Nela Lamp Division, under the supervision of Mr. P. J. Pritchard. Mr. Wm. T. L. Cogger was also detailed as Special Engineer to assist Mr. Pritchard and co-operate with the engineers of the Research Laboratory, with the view of taking the developments and placing them in commercial operation.

A few days after the meeting, some samples were received from Schenectady and, except for the peculiar constructions in the interior, the samples were somewhat like lamps. In general, the construction resembled Miniature Auto Headlight Lamps, yet involved much more detail and appeared decidedly complicated. Certain general suggestions were made regarding the construction, with the view of adopting lamp-making equipment to the manufacture of the tubes. These suggestions were incorporated into a few sample designs and models.

At a meeting held in Harrison, New Jersey, on Sept. 24, 1917, Lieut. Bown of the Signal Corps, engineers from the Research Laboratory and engineers from the Edison Lamp Works and National Lamp Works were present. The models prepared by the National Lamp Works were approved as suitable, the Research Laboratory furnished the specifications for the different parts, and plans were made to begin a small production. At this meeting, on account of their geographical position, it was decided that the Edison Lamp Works would co-operate with the Research Laboratory and Providence Base Works in the development of the special base for these tubes, and that the National Lamp Works would co-operate with the Research Laboratory and handle the development of the special packing material for the tubes.

EARLY "GRIEF" ENCOUNTERED IN MANUFACTURE

With the general point of construction decided at the meeting in Harrison a small commercial production was planned in Cleveland. In all cases, except where machine operations were possible without affecting the quality of the product an endeavor was made to follow the processes and operations exactly as performed in Schenectady. This plan resulted most satisfactorily and although, in many cases, it was slow, costly and seemingly unprogressive, it prevented losses due to failure of untried methods. Having demonstrated that they could successfully make these tubes according to laboratory practices and methods, the Nela Lamp Division fellows next turned their attention to commercial production. It was soon found that they had a real problem on their hands.

Stem-making in *lamps* was considered fairly easy, and it was with confidence that they converted over a stem machine to put six leads through the stem, spaced 1/16 inch apart. It required more than that, however, for they ran into all the difficulties that could happen to stems—cracks, leaks, burnt welds and all sorts of glass troubles, each requiring every bit of lamp knowledge and experience that could be commanded in order to solve the difficulties.

Coil-making for the filament and grid was one of the most painstaking and careful operations. Mandrels of molybdenum were made and accurately threaded to give proper coil size, shape and pitch. The mandrels were carefully wound with filament and grid wire and sintered in hydrogen furnaces. After experimenting, a best process was found which gave accurate coils. Mounting was found to be most difficult, due to the accuracy required in the spacing between filament and grid, and the necessity of mounting without any strain. The preparation and mounting of the nickel cap which was used as the plate, presented many problems but these were finally solved.

Finally, after making numerous minor changes in design of parts, etc., to improve mechanical strength and facilitate manufacture, a lot of tubes were sealed ready for exhausting.

EXHAUST PROVES A TOUGH PROBLEM

Up to the time that the National Lamp Works started work on pliotrons, all the tubes at Schenectady were exhausted by means of mercury condensation pumps, and there was some doubt regarding the possibilities of exhausting the pliotron on the more economical oil pumps commonly used in lamp manufacturing, due to the fact that sufficiently low pressure could not be obtained on the small rotary oil pumps. The Research Laboratory at Schenectady, however, became quite active and found a means and schedule for exhausting pliotrons on an oil pump and forwarded the information to Nela Park. The equipment was placed in shape and the necessary procedure started, in order to perfect the vacuum by the "Bombardment Process of Exhaust." The results in Schenectady had appeared to be most satisfactory.

The first Nela pliotrons were placed on the exhaust bench, and after two days of unsuccessful trials to complete the vacuum the Research Laboratory at Schenectady was called upon and an expert was sent to demonstrate the process. It was then discovered that insufficiently detailed instructions from Schenectady were responsible for the failure to exhaust the pliotron at the first attempt. Thirty or more tubes were now exhausted and on October 19, 1917, these were taken by Mr. Cogger to Schenectady for test.

The tests at Schenectady showed that of these original 30 pliotrons, one-third of the tubes were better than the average product of Research Laboratory, one-third about average and the other one-third were very inferior. This was due mostly to defects of manufacture. This creditable showing was commented on by the Research Laboratory, and Nela Lamp Division was complimented and given every encouragement to produce more tubes as good as these samples.

The production of 100 tubes was immediately started and, under instructions from the Research Laboratory, equipment and instruments were set up for testing the tubes as made. From these tests and from the rapidly increasing fund of experience and information, means of improving the quality and facilities of manufacture were soon found.

Before November 1st, 1917, these 100 tubes were completed in Cleveland. The Research Laboratory had submitted samples of pliotrons made by the National Lamp Works to the Navy, and an order for 1,000 was received to be made as per the samples submitted. This order marked the beginning of production, and the necessary steps were taken to build up an organization and lay out equipment with the idea of making a production of 200 tubes per week.

COMPLIMENTS FROM WASHINGTON ON SUCCESSFUL PRODUCTION

The Research Laboratory at Schenectady furnished most of the testing equipment for the necessary radio test, and pliotrons, as made, were tested on these instruments and then packed and shipped to the Navy Yard at Washington, D. C. Here the tubes were inspected by the Navy inspectors. The Nela Lamp workers were greatly pleased to learn that only seventeen tubes were rejected from the entire lot of 1,000 for all causes—mechanical, radio and electrical. This was a record, and Mr. Pritchard felt justly proud of his Division, for attaining it, since with less than a month's real experience with this new problem, the Division was able to deliver the first 1,000 tubes and have a rejection of less than 2% for all causes.

The Signal Corps was now becoming interested in the G. E. tubes, and samples were submitted by Schenectady to the Signal Corps, all samples being made by the National Lamp Works. In order to meet special requirements of the Signal Corps for voltages, etc., considerable changes were made in the filament. Finally, several designs were submitted to the Signal Corps.

In the meantime, the Chief Signal Officer asked the General Electric Company to endeavor to manufacture the Western Electric type of vacuum tube, as this tube was giving satisfactory results, and a greater production was required. To this end, the Research Laboratory called a meeting of the representatives of both the Edison and the National Lamp Works with the view of investigating the process and methods of manufacture of the W. E. tube at the New York Laboratory. Mr. Pritchard and Mr. Cogger were detailed by Mr. Roberts to represent the National Lamp Works. Investigation was made and a report written up. This report very clearly convinced both the Western Electric Company and the Chief Signal Officer that the manufacture of W. E. tubes was not commercial in a lamp-manufacturing division.

The Signal Corps now became actively interested in the G. E. tubes, and finally, on January 23, 1918, after tests in Schenectady, National-made tubes designated as NX4 were accepted for manufacture. The question of the rate of manufacture was raised, and Nela Lamp Division went on record as being able to produce 250 per day immediately, and to increase the production gradually to 2,500 per day within 120 days. To the surprise of all engaged in the work, the order came through for 40,000, with a production schedule only one-sixth as heavy as that which we had told the Government we could meet. It appears that the Government officials did not believe that a production as great as was estimated at Nela Park could be obtained, and therefore production was put on a weekly basis with quantities equal to our daily production promises.

CREATION OF THE VACUUM TUBE DIVISION

Lieut-Col. Slaughter, Lieut. Cameron, Lieut. Bittner and Lieut. Littell came to Cleveland just after the order was placed, to make an inspection of the plant and learn of the National Lamp Works' organization and plans. They were favorably impressed and were assured of the Division's ability to manufacture and deliver tubes. Specifications were agreed upon and actual production started. In order to designate the work as a separate activity, the Vacuum Tube Division was organized, with Mr. Pritchard in charge. The General Letter of April 4, 1918, issued by Messrs. Terry and Tremaine and authorizing the establishment of this Division, follows:

> *Vacuum Tube Division No. 151*
>
> This is a new division that has been opened for the manufacture of special articles, most of which will not be articles belonging to our regular line of goods as disposed of by our sales divisions.
>
> This division will be located at Nela Park, and will be in charge of Mr. P. J. Pritchard.
>
> TERRY AND TREMAINE
> Managers.

With the Vacuum Tube Division organized and operating on a commercial basis, the work did not settle down to a mere matter of routine, by any manner of means. New tubes for different uses were constantly being developed at the Research Laboratory at Schenectady, and as soon as the ideas were perfected the Research Laboratory sent word to Cleveland, whereupon the Vacuum Tube Division immediately took steps to put the tubes on a commercial production basis.

On February 9, 1918, in co-operation with Schenectady, commercial development was started on the transmitting pliotron tube and the regulating kenotron. During these developments, a regular production schedule of receiving tubes was followed and, at one time, 96 tests of different kinds and descriptions were going through the Vacuum Tube Division. Ordinarily, it would have taken a year to complete the tests in the Research Laboratory at Schenectady, but the Division at Nela was able to clean up the tests in two weeks. This work which was done without interfering with regular production, gave the Vacuum Tube Division such a reputation for service and efficiency with the Research Laboratory that all commercial development for new types of pliotrons, from this time on, was done at Cleveland.

WONDERFUL IMPROVEMENTS MADE IN THE TUBES

During the commercial production of receiving tubes, hardly a week went by without improvements either in the quality of the product or in the facilities for manufacture.

The method of exhaust had proven unsatisfactory from the very first. Not only was the process long and tedious, but the vacuum finally obtained was not sufficiently low to insure perfect operation of the tubes. All sorts of experiments were tried, including the use of chemicals, in the endeavor to find a better method. Palladium black was introduced in the top of the tube as an absorbent for the gases given off by the metal parts. A little later, a form of charcoal, very similar to that used as canister-filler for gas masks, was tested and proved quite successful.

Early in May, 1918, an exhausting procedure was evolved which was revolutionary both in the speed with which the tubes could be exhausted and in the completeness of the exhaust. A chemical, similar to the so-called "getter" used in exhausting MAZDA B lamps, was introduced in the top of the bulb. The use of this chemical in connection with the "Bombardment Process" of exhaust previously mentioned, proved to be by far the most satisfactory of all the exhausting methods then in use. Enough of the chemical was used to take care of the small amount of gas constantly emitted by the metal parts during the actual operation of the tube.

When the first pliotron manufactured was rated on a "Cable Box," an arbitrary method of comparing quality, it gave an amplification rating of 8 miles. Within a month this rating was raised to an average of 12 miles, and before 10,000 tubes were made the average was 16. By the time 25,000 tubes had been manufactured, this average rating was over 20 miles. The direct measure of quality varies as the square of these ratings or in the ratio of 64 for the first tubes, to 400 for the last tubes on order. *This meant an increase in quality of over six times!* The life of the tube was also increased (from 300 hours to 2,000 hours) and, as a result, the tubes gave the Government *seven times the life expected.* In addition to this, wonderful improvements were made in uniformity of the product.

All this progress, however, was not made without difficulty. On one occasion, out of nearly 2,000 tubes that had been made up, not a single one was good for anything. Several times the Division was confronted with losses of thousands of dollars, due to imperfect raw materials and uncontrollable circumstances. All of these problems kept every man working night and day, and required the best possible supervision and engineering.

One of the greatest handicaps under which the Division was working during these months, was the limited production schedule imposed by the Government. Continued requests were made for release from this restriction, in order to make it possible to obtain more efficient operation by means of a greatly increased rate of production. Finally, the superior quality and operating characteristics of the tubes excited the interest of the allied governments; the G. E. Research Laboratory received a request from the British Admiralty for tubes, and immediately asked for increased production. This time the Vacuum Tube Division promised to reach a production of 3,000 tubes per day within sixty days, and began to make plans to produce this number of tubes. The order failed to materialize, however, but with permission from the Signal Corps a maximum production of 1,800 tubes per day was obtained. As a result, the Division would have been able to carry out its promises quite easily. Having completed the receiving tube order ahead of schedule, however, the Division ran out of orders and was forced to ask for more orders to keep the plant in operation. It became evident that the Vacuum Tube Division was so far ahead of the Government program that it was necessary to cut production, as more pliotrons were being made than the Government could handle. The Division was complimented for its proven ability to deliver tubes in large quantity and, while so doing, to make wonderful improvements in the quality of the tubes.

Generally speaking, the production of pliotron transmitting tubes and of kenotron regulator tubes was a repetition of the receiving tube experience. The Division improved quality, made deliveries on or ahead of schedule, and was always ready in an emergency to take up new developments or to make new types of tubes.

A medium-power transmitting tube was finally developed for the Navy, close co-operation with the G. E. Research Laboratory being maintained throughout the entire development period. This development, while not complete, was probably the most wonderful of all from a technical standpoint, due both to the equipment developments involved to produce the parts, and to the careful work required to produce these tubes successfully. Special tubes of various types, and innumerable parts, stems, mounts, etc., were produced at Nela for experimental use by the G. E. Research Laboratory at Schenectady.

The following is a list of the total number of tubes manufactured and shipped from Nela Park.

Receiving Tubes	77,290
Transmitting Tubes	36,649
Regulator Tubes	49,575
Resistance Tubes	5,998
Special and Misc.	9,803
TOTAL	179,315

It is of interest to note here that the Vacuum Tube Division of the National Lamp Works manufactured and delivered three times as many tubes as any other organization engaged in the same class of work.

The question of the price of the tubes was handled at Schenectady and contracts were made on a definite price basis, the price being determined from the actual cost figures of manufacture of the pliotrons submitted to the Government. While the price received for the tubes did not result in any big profit, it was sufficient to cover any reasonable cost.

Of course, no return was received on the fund of information and experience collected from years of lamp-making development, which was responsible for the success of the Division in the commercial manufacture of pliotrons. Knowledge of tungsten filament wire, glass, platinum substitute, pumps and all manufacturing equipment is very properly considered as being one of the important intangible contributions of the National Lamp Works towards the winning of the war.

USES OF THE VARIOUS TUBES MANUFACTURED

The particular uses to which these pliotron and kenotron tubes were adapted by the Government are as follows: First, as detectors and amplifiers in the reception of wireless telegraph and telephone signals; second, as oscillators and modulators in the transmission of wireless telephony; and third, as regulating devices for variable-speed generators mounted on airplanes for supplying high voltage to the transmitting tubes.

TYPES OF RECEIVING TUBES

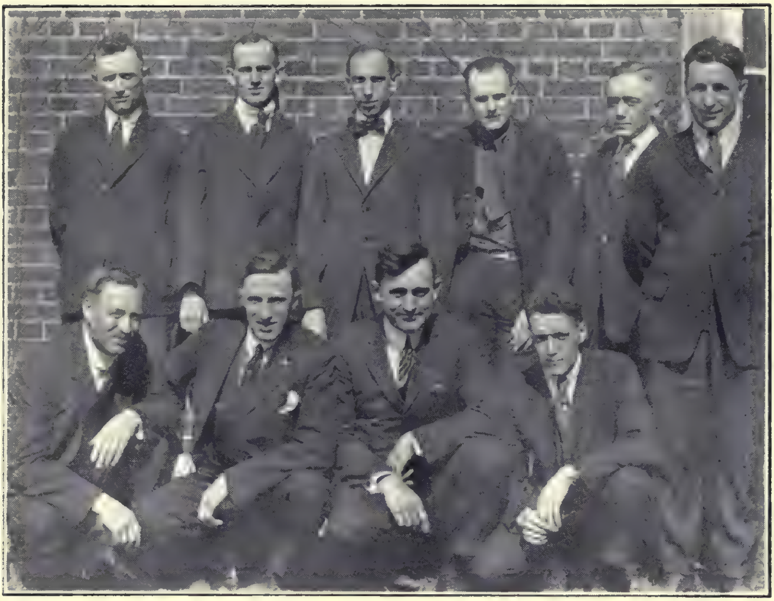
The detailed theory of operation of the receiving tube is highly technical and is therefore omitted from these pages. It is sufficient to say that the vacuum tube (pliotron) is, by far, the most satisfactory type of detector for wireless signals so far developed. The simplicity of the receiving circuit, together with the fact that it is always constant and never out of adjustment, makes the vacuum tube the most reliable feature of the wireless receiving equipment.

The first receiving tube made by the Vacuum Tube Division was merely a laboratory sample, designated as the G-20. The making of this one tube furnished a fund of information and experience which later proved quite invaluable, and from which the commercial developments on receiving tubes started.

The principles of construction used in this first experimental tube were incorporated in the receiving tube, Type CG-886, which was the first commercial type manufactured. This tube was supplied to the U. S. Navy to be used as a detector, amplifier and oscillator, both aboard ship and in land stations, and was usually operated in series with a resistance on a three-cell storage battery. The construction of this tube embodies a tungsten filament, a tungsten grid and a nickel plate, all elements being cylindrical in form. The base used for this tube was the old type of 3-pin navy fibre base, which was later superseded by a 4-pin standard base used by both the Navy and the Signal Corps of the U. S. Army.

A little later, the Type VT-11 tube was developed for use by the Signal Corps of the U. S. Army as a detector, amplifier and oscillator for both

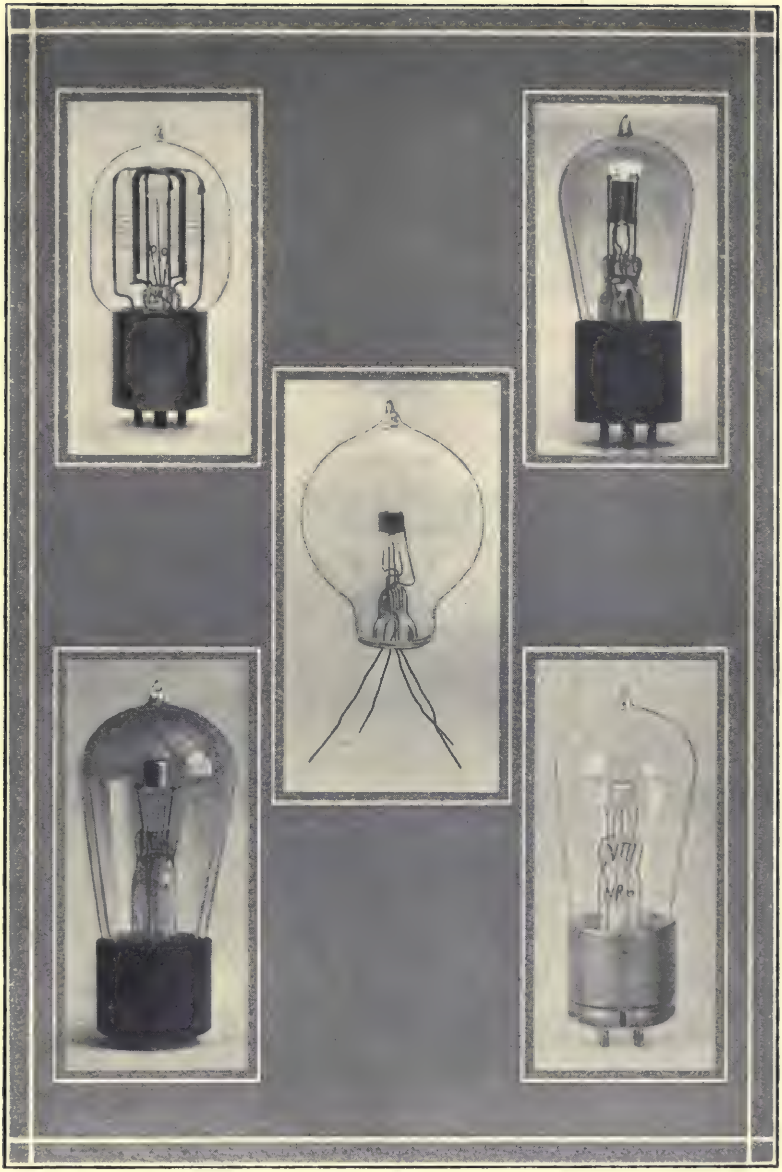
The Lamp Laboratories Building at Nela Park. Here the Development Work on X-Ray and Vacuum Tubes was Conducted.



Men in Charge of X-Ray and Vacuum Tube Work at Nela Park.

Lower Row: P. J. Pritchard, C. B. Robinson (U. S. Inspector), W. T. L. Cogger, W. H. Steven.

Upper Row: John Smith, L. E. Mitchell, Frank Moran, James Hagey, John Hapgood, Arthur J. White. Mr. P. F. Stokes was absent when the photograph was taken.



Types of Receiving Tubes and Amplifier Tubes, made by the Vacuum Tube Division

Top Row—left to right: C. A. Tube, V T-13.
Center—Laboratory Sample No. 1.
Bottom Row—left to right: CG-886, VT-11.

field and air service. The tube is operated directly across a two-cell lead storage-battery without any resistance in series. The construction of this tube embodies a tungsten filament, a tungsten grid and a nickel plate, all elements also being cylindrical in form. The base used on this tube was the base standardized for receiving tubes by both the U. S. Army and Navy.

Another tube, which was in the development stage at the time the armistice was signed, was the Type VT-13. This is a modification of the VT-11 tube, the endeavor being to improve both the ruggedness of the tube for airplane service and its radio characteristics. The service of this tube was identical with the VT-11.

AMPLIFIER TUBES

When wireless messages are too weak to be heard in the telephones of the detector circuit in the receiving station, a second vacuum tube is inserted which amplifies the signals and increases their audibility. This second tube is called an amplifier and, in many cases, the signal is 100 times greater in audibility due to the use of the amplifier.

Such an amplifier tube, known as Type CA, was developed for use by the Navy in connection with high-speed photographic receiving apparatus. It was a special tube developed to obtain the maximum amplification and embodied a tungsten filament with a finely wound tungsten grid and a tungsten plate.

TYPES OF TRANSMITTING TUBES

The second use of the tubes, as transmitters, was not completely developed before the armistice was signed, but a large number of tubes were constructed and used on submarine chasers, airplanes and flying boats for wireless telephony communication up to about 12 miles. Inasmuch as the transmission of wireless signals for any distance involves considerable power, the tubes used in transmitting stations had to be of a heavier and more rugged type of construction than the receiving tubes.

The first transmitting tube produced was a laboratory sample, from which the full line of tungsten-filament transmitting tubes was developed. The transmitting tube "Type VT-12" was the first commercial development, and was used by the Signal Corps of the U. S. Army for wireless telephony in airplane service. This tube was an endeavor to duplicate the electrical specifications of the VT-2 developed by the Western Electric Company. It embodied a tungsten filament, a tungsten grid and a molybdenum plate, all elements being cylindrical in form. The limit to the amount of power which could be supplied to the tungsten filament limited the range of wireless telephony transmission, with the sets originally developed for Western Electric tubes, to about three miles. This tube was finally superseded by the VT-14.

The transmitting tube "Type VT-14" was developed to give the same transmitting range, in sets developed by the Western Electric for the Signal Corps, as was given by the VT-2. The construction and details of the VT-14 are exactly similar to those of the VT-12, with the exception of a greater power input to the filament. This tube, when used on airplane service, had a transmitting range of from 10 to 15 miles in wireless telephony. The VT-14 was also adopted by the U. S. Navy, and called by them the CG-1162. It was used on submarine chasers and flying boats, with a sending range of about 15 miles.

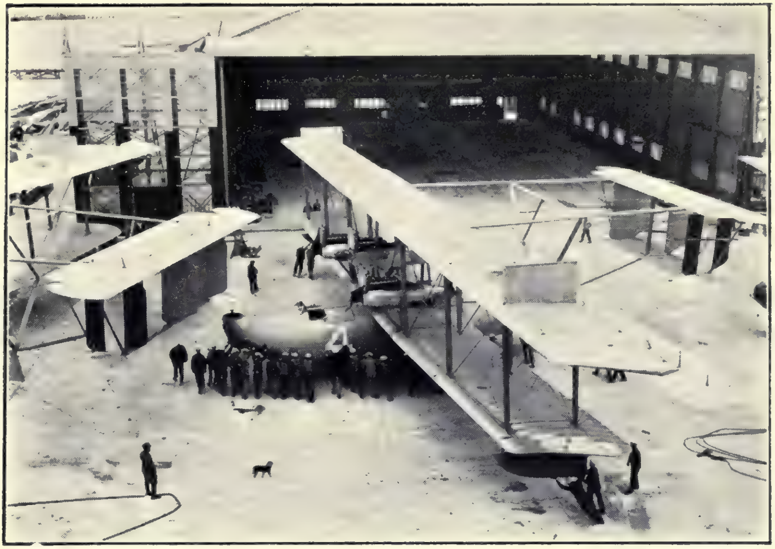
Another type of tube, Type VT-16, was in the development stage for the Signal Corps of the U. S. Army at the end of the war, and was constructed with the endeavor to improve the mechanical strength of the tube for airplane service and to perfect its electrical and radio characteristics.

PRESIDENT WILSON TALKS 600 MILES THROUGH A VACUUM TUBE

At the beginning of the development of transmitting tubes, two miles was considered a most excellent showing for wireless transmission of speech, in view of the difficulties encountered on airplanes, flying boats and submarine chasers. The rapid progress which was made in the development of these tubes led to further developments, and shortly after the armistice was signed a flying boat established communication off Norfolk at a distance of about 80 miles. A little later, the Vacuum Tube Division, co-operating with the Research Laboratory at Schenectady, developed a medium power transmitting tube for wireless telephony, known as Type CG-1144. This tube was used by the Navy on flying boats and aboard ship, for transmission of wireless telegraphy and telephony. It embodied a tungsten filament, a tungsten grid, and a molybdenum plate, and was designed to use a higher plate voltage than the VT-12, VT-14 or VT-16. This tube had a transmitting range of from about 50 to 175 miles, a flying boat establishing communication with Secretary Daniels in Washington at a distance of 150 miles at sea. The range could be increased by using several of the tubes in parallel, successful communication being established between President Wilson and Secretary Daniels when the "George Washington" was 600 miles out of New York. From the time when this conversation started wireless telephone communication was successfully maintained until the ship reached harbor.

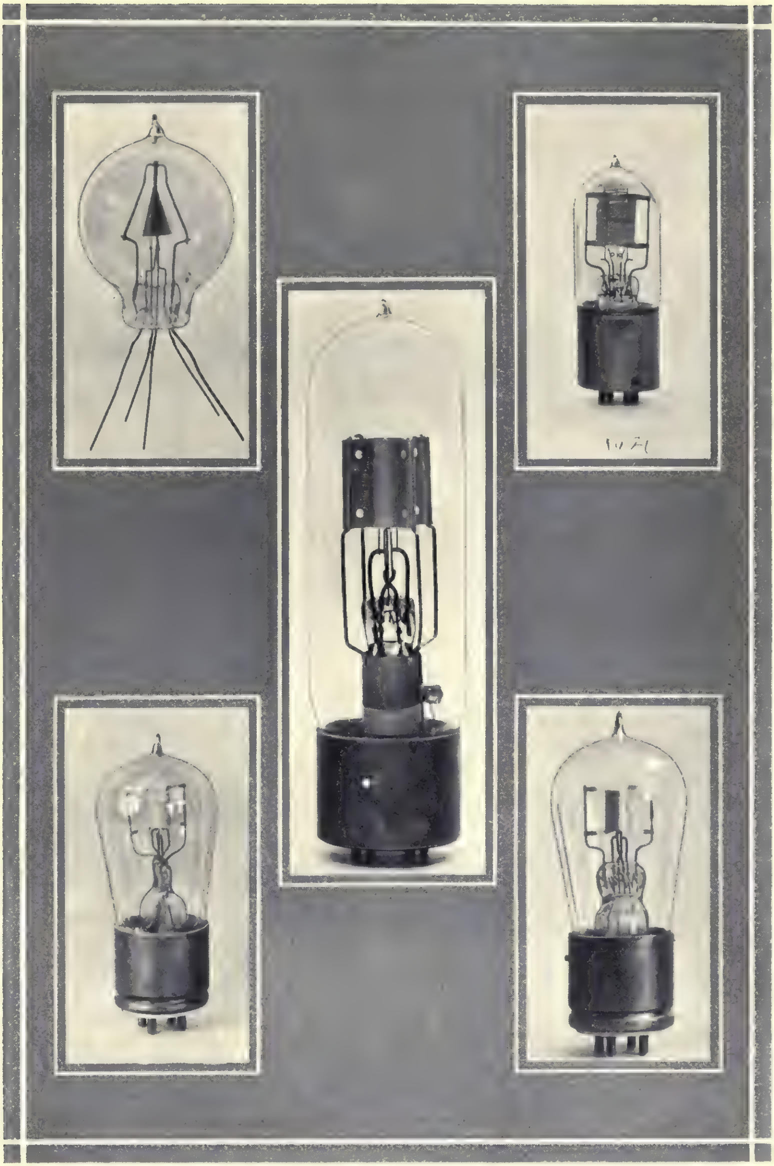
FIRST AIRMEN TO FLY ACROSS ATLANTIC USED VACUUM TUBES

While lying in harbor at Brest, France, awaiting the arrival of President Wilson for his trip home, the George Washington maintained successful communication with the famous trans-



The famous Flying Boat NC-4 which was the first trans-Atlantic plane. Using CG-1144 Vacuum Tubes, the NC-4 maintained communication with the George Washington until 50 miles away.

The U. S. Naval Transport George Washington which carried President Wilson to and from the Peace Conference. CG-1144 Vacuum Tubes were very successfully used in both Wireless Telephony and Wireless Telegraphy sets on board this ship.



Types of Transmitting Tubes Manufactured

Top Row—left to right: Laboratory Sample No. 2, VT-16.

Center: The CG-1144 which was used in sets on the Seaplane NC-4 and the U. S. S. George Washington.

Bottom Row—left to right: VT-14, VT-12.

Atlantic plane NC-4, which was then passing over Brest *en route* from Lisbon, Portugal, to England. The George Washington talked to the NC-4 by radio phones, and the crew of the NC-4, telegraphing their replies back to the George Washington, stated that the phone signals were coming in "loud enough to hurt their ears." Both the radio telephony and telegraphy transmitting sets were using CG-1144 vacuum tubes. Communication was maintained until the plane was well over 50 miles away. The perfect reception on board the George Washington of the signals from the NC-4 was considered even more remarkable when it was learned that the plane, on account of heavy fog forcing it to fly low, was not using its main antenna.

The latest type of tube which was developed by the Vacuum Tube Division was successfully used for wireless telephone communication between Brunswick, New Jersey, and Brest, France. This medium power tube was developed to withstand the necessary mechanical strains in connection with airplane service and to give the most reliable service in all of its electrical and radio characteristics.

With regard to the transmitting tube, the Vacuum Tube Division of the National Lamp Works were the only successful manufacturers of this type of tube. The tubes were used almost exclusively by the Navy in their equipment for submarine chasers and flying boats, and were pronounced as being singularly free from operating troubles and as giving the most satisfactory results. This development was beyond the fondest hopes of the engineers connected with radio development, especially wireless telephony.

REGULATOR TUBES (KENOTRONS)

The regulator tube "Type TB-1" was used in regulating the voltage across the terminals of a fan-propelled generator for airplanes. This is a two-element tube or kenotron, embodying a tungsten filament and molybdenum plate, and was so connected into the field and armature windings of the generator that with airplane speeds varying from 40 to 180 miles per hour, corresponding to armature speeds of 3,500 to 18,000 revolutions per minute, the voltage did not vary more than 10 per cent. The construction of this tube was such that it withstood mechanical vibrations in airplanes without any effect upon its electrical behavior.

The use of these tubes with the generator equipment very materially decreased the amount of weight required to provide the necessary voltage for wireless communication. They were used exclusively on American planes, and, from all reports, were entirely successful.

In all of the developments of the tubes used on airplanes, it was necessary to cover the construction specifications most thoroughly, so that the tubes would meet the service required. The vibrations of the plane and the sudden shocks and jars of landing necessitated the most accurate and rigid designs on all types of tubes. By means of the most elaborate internal construction we met all requirements of the service. The wonderful part of all of the development activities was the speed with which most successful designs were placed in production and delivered to the Government, and the surprising uniformity and improved quality which resulted from concentrated effort on commercial production. Articles published in the various technical magazines by members of the Signal Corps and by those connected with this radio development, speak very highly of the progress that was made in wireless telephony during the war, and a major part of the credit is due to the development of the vacuum tube, without which it would have been entirely impractical to have attempted wireless telephony in the air service.

THE GRID LEAK AND SPECIAL TUBES

The grid leak tube, a small cylindrical vacuum tube, was developed as a necessary auxiliary tube to be used in connection with the larger transmitting and receiving vacuum tubes in wireless telephony outfits, as a leak around the blocking condenser used in the grid circuit. Grid leaks were made having a resistance of 500,000, 2,000,000, and 10,000,000 ohms. The resistance is formed by deposits of metallic tungsten in a film between the two terminals of the grid leak.

A special relay tube was also developed for John Hays Hammond, Jr. This was a specially designed tube used as a relay in connection with the wireless control of torpedoes.

X-RAY TUBE MANUFACTURE AT NELA PARK

THE USE OF X-RAYS IN THE WAR ZONES

A very important piece of specialized war work performed by the National Lamp Works, co-operating with the Research Laboratory at Schenectady, had to do with the development and manufacture of X-Ray tubes. The great value of X-Rays as an aid to surgical diagnosis was well known at the beginning of the war. They had long been recognized as being the most effective means known for locating foreign bodies and for the scientific treatment of fractures and dislocations. But while thousands of American hospitals were using X-Ray outfits, these outfits were designed as being inherently stationary and no thought—certainly no development work—had ever been given to the design of a *portable* set.

More or less stationary types of X-Ray outfits had been developed by the other allied countries, and were in general use at points somewhat behind the then stabilized fighting fronts.

The many months of actual war experience gained by the allied army surgeons had taught them that by far the most effective use of the X-Rays could be made at a point as close as possible to the field-dressing station where the wounded soldier received his first-aid treatment. It was also highly important that the X-Ray examination of the patient be made as soon after the wound was received as possible.

The desired use of the X-Rays near the battle fronts, however, presented many very serious difficulties. In the first place, the X-Rays are generated by a high-tension current, usually ranging from 40,000 to 90,000 volts, discharging through a vacuum. Prior to our entrance into the war, all the tubes which were designed to provide this vacuum required a direct-current supply. The apparatus required to generate and to control this high-voltage direct current was, of necessity, heavy and complicated and required an expert operator to keep it in adjustment. These features made its transportation and use along a constantly moving battle-line impossible. Recognizing the immediate need for the development of an efficient portable X-Ray outfit, each of the allied armies was engaged in research work on the problem when the United States entered the war.

THE COOLIDGE TUBE MAKES X-RAYS PORTABLE

Following an extensive series of investigations by Dr. Langmuir of the Research Laboratory at Schenectady, resulting in the discovery of many entirely new principles regarding electrical discharges through a vacuum, Dr. Coolidge, also of the Research Laboratory, produced a new radiator type X-Ray tube, radically different from any tube theretofore constructed. Tests of this tube conclusively proved it to be the most powerful, effective and dependable X-Ray tube ever made.

So satisfactory was this tube that it was immediately standardized by the Red Cross for use in its hospitals overseas. With the Coolidge tube as a basis, two complete portable outfits were developed for the Medical Corps of the U. S.

Army. These outfits were known as the "U. S. Army Portable Outfit" and the "U. S. Army Bedside Outfit." The Portable Outfit formed an entirely independent unit and was mounted on a small automobile truck so that it could be taken to any part of the front lines, ready for immediate operation. The Bedside Outfit was made for use in more permanent locations, such as hospitals back of the lines, and was so constructed that X-Ray photographs and diagnoses could be made with very little inconvenience to the patient.

The Coolidge tube had the property of producing its own direct current from an alternating current supply under much more severe conditions of service than was permissible with any of the older tubes and, as a result, could be directly connected across the power transformers. It was capable of practically continuous operation and required very little control apparatus. These features eliminated the heavy complicated auxiliary apparatus which was formerly attached to the outfit, and reduced the total weight to such a point that comparatively high-power portable outfits could be designed for field service. Also, on account of the simplicity of the tube and of the apparatus with which it is used, a great deal of the skilled attendance which was required for older types of apparatus was made unnecessary.

The bulb of the Coolidge tube could also be much smaller than was permissible with the earlier types of tubes handling an equal amount of energy. Another feature, particularly attractive from the standpoint of the men actually working under the penetrating rays of the tube, was the fact that a close-fitting tube shield could be used, even for very heavy duty. This added much to the safety of operation, and less care had to be taken to avoid burns.

FORMATION OF THE X-RAY TUBE DIVISION, NATIONAL LAMP WORKS

The demand for the new tube increased so rapidly that about the middle of April, 1918, it became apparent to those closely in touch with the X-Ray situation that a new manufacturing plant would have to be started in order to meet the requirements of the Government. A meeting was held in Schenectady which was attended by those persons interested in the work there, and by representatives of both the Edison and National Lamp Works. It was decided at this meeting that the National Lamp Works should open the new plant.

The proposition was put up to Mr. Pritchard by Mr. Roberts, and arrangements were immediately made for a couple of men from Nela Lamp Division to accompany Mr. Pritchard and Mr. Cogger to Schenectady to see just what apparatus and material was needed to get started. They arrived in Schenectady on April 25th, and soon found that the job was quite different from making lamps. The glass work was about the only thing which looked in any way familiar to them. Even that appeared difficult, and they were told that only experts could do it.

On account of the many metal parts in the tube, there was a great deal of machine-shop work in getting these parts ready for use. The Nela Park representatives also found that the tedious work required in assembling some of the parts had been successfully accomplished only by expert jewelers. The exhaust was very different from anything they had ever tackled, it being necessary to use mercury condensation pumps to get the vacuum, and a voltage as high as 30,000 to bombard the parts, in order to release the gases held by the metal.

A complete list of material and equipment required was made out at once, and orders were placed for everything. Arrangements were also made to send people from Nela Lamp Division to learn every part of the work. Wherever it was necessary to purchase anything outside the General Electric Organization, a special representative of Nela Lamp Division was sent with the order and in many cases brought the desired article back with him. In every such case, prompt delivery was obtained and much valuable time saved.

On May 7, 1918, the X-Ray Tube Division was organized. An extract from the general letter issued by Messrs. Terry and Tremaine, authorizing this Division, follows:

> ### X-RAY TUBE DIVISION NO. 152
>
> This is a new division that has been opened for the manufacture of the Coolidge X-Ray tubes. They will be made, for the present at least, to help out the department at Schenectady that has heretofore

been making these tubes. We will not sell these tubes to the trade.

This division will be located at Nela Park and will be in charge of Mr. P. J. Pritchard.

TERRY AND TREMAINE
Managers.

THE PROGRESS AND ACCOMPLISHMENTS AT NELA PARK

While some of the people from the National Lamp Works were learning the work in Schenectady, Mr. Pritchard and his assistants were doing their utmost to get the equipment installed. The place chosen was the room formerly occupied by the cafeteria, in the Lamp Laboratories Building, Nela Park.

The X-Ray Division contract called for the delivery of 100 tubes per week within 90 days after the equipment was installed. Unexpected delays on machines furnished by Schenectady held up the completion of the equipment job considerably, and it was not until the second week in August that the Division had any tubes to exhaust. A new crop of troubles came up in connection with the exhaust work, which at first seemed unconquerable. Very little help could be obtained from Schenectady because the troubles of the Research Laboratory were about as great as those at Nela Park. Progress was slow at first, and it was only after many disappointments that it was possible to take satisfactory tubes off the pumps. A definite method of procedure was finally worked out, which enabled good tubes to be turned out with very little trouble.

The X-Ray Division had produced several hundred tubes, and was rapidly getting in such a position that a great many more than the required one hundred tubes per week could have been delivered, when the armistice was signed. The Government, of course, cancelled practically all of its orders and the Division was forced to suspend operation as soon as the parts of tubes in process were cleaned up.

Many improvements were successfully worked out and incorporated in the various processes of manufacture, therefore permitting a much larger production rate to be attained. It may be interesting to mention a few of the things, at least, in which the Division was particularly successful, and in which it was able to make striking improvements in the processes as originally demonstrated and used by Schenectady. The extent to which the bulb-blowing operations were modified and improved may be realized when one considers that while 25 tubes were considered a good *weekly* production for a glass blower in Schenectady, the X-Ray Division at Nela Park so speeded up the difficult processes involved that one man was able to turn out 19 tubes *in one day*, or over 100 per week. At the signing of the armistice, sufficient machine operations had been introduced to bring the production of two men and a girl, working together, up to 60 tubes per day at least as far as the glass work was concerned. This would be a minimum weekly production of 330 tubes for three people. The maximum weekly production at the Schenectady laboratory for three people was 75 tubes.

Girls were employed to do many operations in the machine shop which were done in Schenectady by men, and this, together with the working out of many short cuts in the preparation of the metal parts, saved considerable time over the laboratory methods used in Schenectady. The Division was also successful in teaching girls to do the work performed by the jewelers in Schenectady, and the amount of work turned out by the girls at Nela Park was about double that turned out by the highly specialized jewelers. Changes were also introduced in the exhausting procedure which shortened the exhaust schedule by approximately one and one-half hours.

On account of the cancellation of the Government contracts immediately following the signing of the armistice, the National Lamp Works sustained a direct financial loss of many thousands of dollars. The suspension of active operations, just at the point at which the Division was in good shape to go ahead, offered no chance of covering the great expense incurred in getting started.

THE TRIBUTE OF THE G. E. RESEARCH LABORATORY

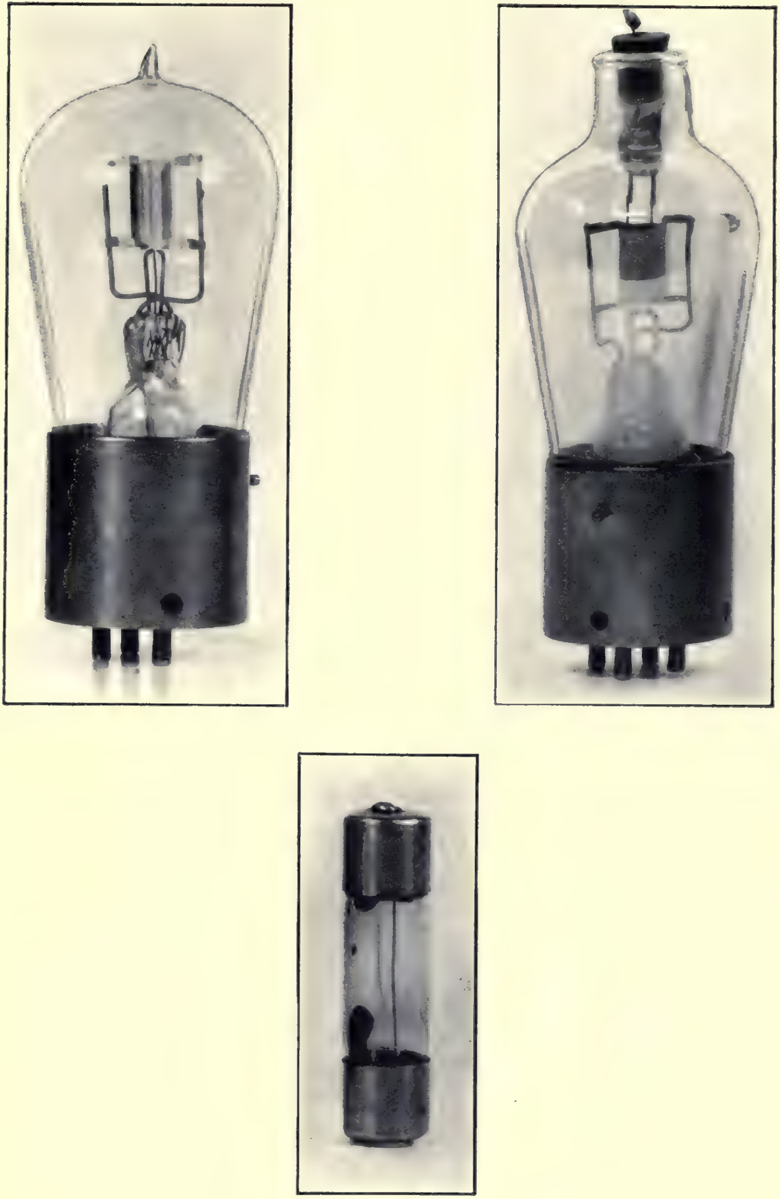
The work of both the Vacuum Tube and X-Ray Divisions necessarily involved their very close co-operation with the Research Laboratory at Schenectady. That both Divisions worked in harmony with the Research Labratory is shown by the following extracts from a letter written by Mr. Hawkins to Mr. Pritchard, under date of January 20, 1919.

"During the year, we have repeatedly called on your Vacuum Tube Division to complete the engineering development work and get quantity production started on pliotron tubes whose designs had been only partially worked out in the Laboratory. These jobs were not a very attractive proposition for a lamp factory, but in every case they were attacked by your Vacuum Tube Division with such skill and energy that you were not only able to produce the quantity of tubes we requested, but the quality was superior to that of the tubes we were able to produce in the Laboratory, and the work was done in shorter time than we thought possible.

"You invariably fully utilized all the technical knowledge and experience we had to give, and by supplementing this with your own skill and experience, you gave us a product better than we had expected. We never have experienced more thorough and effective co-operation from any department of the Company than your Division has given us. Without that co-operation, we could not have accomplished what we have for the Navy, which today seems to look to us solely for the working out of any new problems in radio.

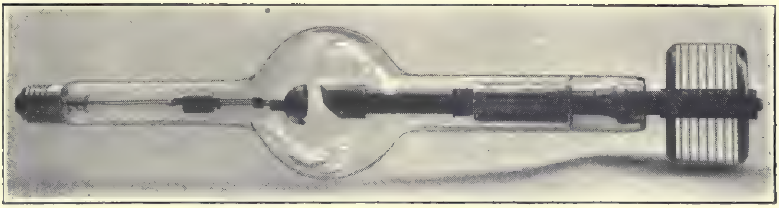
"The X-Ray Division was started at our request that Cleveland should put itself in a position to supplement our production of Coolidge tubes of the radiator type, which had been standardized for Red Cross Work. We were afraid that our Schenectady factory would not be able to meet the Government requirements and that, even if it could, it would be unsafe to rely on a single factory for a device which was absolutely essential for all surgical work at the front. Like your Vacuum Tube Division, your X-Ray Division tackled a rather thankless job with energy, skill and hearty co-operation. The equipment and methods of manufacture for X-Ray tubes differed much more from those of the lamp factory than did the equipment and methods of manufacture of the pliotron, so that a longer time was required to start production. There was some fear on the part of those in Schenectady that the character of the X-Ray tube work was so new for you, that the amount of help you would need from us in starting would be so large as to handicap our Schenectady production.

"This fear proved to be wholly unfounded. You sent your men on to study our methods and production, and then went ahead with very little help from us to get your production started. This was accomplished in what I believe to be a remarkably short time, and the quality of your product



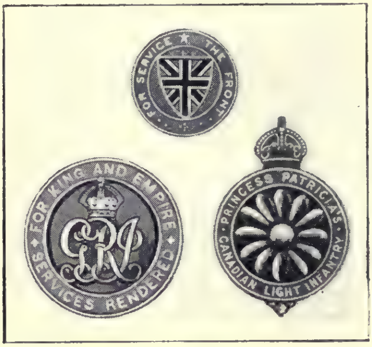
Special Vacuum Tubes Made by the Vacuum Tube Division

Left to right—The TB-1 Regulator Tube which was used in Wireless Telephone Sets in the Air Service; the Grid Leak Tube; the Relay Tube which was designed for Wireless Control of Torpedoes.



Coolidge X-Ray Tube as Made by the X-Ray Tube Division
at Nela Park

Henry Urqhuart
of the original "Princess Pats."
Later with the
X-Ray Tube Division


FOR SERVICE ★ THE FRONT
FOR KING AND EMPIRE
SERVICES RENDERED
GRI
PRINCESS PATRICIA'S
CANADIAN LIGHT INFANTRY

Urqhuart's Insignia
The Cap Insignia at the right dates
from the original
formation of the Regiment

Only a few of the original "Princess Patricias" escaped death in
the War. This photo was taken before the
Regiment left Canada

was excellent. Although the signing of the armistice, and consequent cancellation of orders, have made it unnecessary to continue X-Ray tube production at Cleveland, nevertheless, if the war had continued, your X-Ray Division would have been practically essential to enable the General Electric Company to fulfill its obligations to the Government.

"Outside of submarine detection, the two principal war activities of this Laboratory were Radio and X-Ray tube work. Our successful handling of the first of these would have been impossible, and of the second, doubtful, had it not been for the effective and hearty support received from your two Divisions."

A "PRINCESS PAT" VETERAN AT NELA PARK

Among the 1,050 troops, formed in Lansdowne Park, Ottawa, Canada, on August 23, 1914, who witnessed the presentation of the gold and royal purple colors of the "Princess Pat" Regiment to Colonel Farquhar by the Princess Patricia herself, there is one man whose experiences will be of particular interest to those who read these pages. This survivor, later connected with the X-Ray Tube Division of the National Lamp Works, is Henry Urqhuart, Number 872 of the original Princess Pat Regiment, 80th Brigade, 27th Division.

Probably no regiment engaged on any of the active fronts during the entire World War won higher commendations from the Allied General Staff than did the Princess Patricia's Royal Canadian Regiment of Light Infantry. Certainly no regiment faced a greater ordeal than that which came to these men in the very beginning of their experience, an ordeal which would have tested the most tried of veterans. On April 23, 1915, chlorine gas, an unknown and wicked weapon of warfare, was launched by the Germans in an attack which shattered the gallant forces on the Canadian left and poured an agony of suffocation and death upon the Canadians themselves. The bravest and most experienced troops might well have been daunted by the terrific onslaught to which they were exposed. Attacked by overwhelming numbers, they held their position in the face of terrible casualties and checked the powerful German onrush toward Calais and Paris.

Of the 1,050 men who, late in 1914, went into action as the original Princess Pat Regiment, only a few were left alive at the close of the war. Among these men there was but one officer, Colonel Hamilton Gault, who came back with the regiment in March, 1919, having suffered the loss of one leg. An idea of the heavy casualties suffered by the regiment may be obtained when one realizes that during the bloody years of 1914, 1915 and 1916 alone, sixteen thousand replacements were added to keep up its strength.

URQHUART'S EXPERIENCES PRIOR TO JOINING THE "PATS"

From 1897 to 1902 Urqhuart was in British South Africa and was engaged in active service throughout the Boer War. Here he became acquainted with Colonel Farquhar, later Commanding Officer of the Princess Pats. During the Russo-Japanese War, he accompanied part of the Russian fleet down through the Red Sea and into hostile waters. In March, 1907, he was again in the Far East as a non-combatant in the Chinese Rebellion, witnessing battles for six weeks for the possession of Shanghai Arsenal.

Late in July, 1914, Urqhuart, then in the merchant marine service, was on the British ship Mantua, commanded by Captain Vipert, on a cruise through the fjords of Norway. He arrived at Balhomen ten days prior to the declaration of war, and had the unique experience of standing within thirty feet of Ex-Kaiser Wilhelm, who was at Belhomen at the same time. Unfortunately, the British at this time had no suspicion of the coming events, in which Wilhelm was to play such an important part, so that the latter went unmolested, much to Urqhuart's later regret. An exchange of compliments between the German and British crews was followed by a tour of inspection of the German Dreadnaught "Crown Prince Frederick" by the British officers and passengers. After various stops, the Mantua docked at Copenhagen, where great excitement was in evidence due to the general rumor of the declaration of war. From here, they went to Christiana and thence into the North Sea where, at 11 o'clock on the night of August 3rd, they were hailed by a vessel of the German fleet. Upon replying, the Germans said that war had been declared on Servia, Russia and France. The Mantua was allowed to proceed and went on through the North Sea to the Port of London. A trip to Bristol by rail was followed by Urqhuart's being sent on escort duty to Canada.

THE PRINCESS PATS ARE FORMED AND GO OVERSEAS

Upon Urqhuart's arrival in Canada, the Princess Patricia Regiment was being formed. Aided by the influence of Captain Thompson of the ship Royal George, which later was to take the Princess Pats overseas, and that of Colonel Farquhar, he obtained his release from the merchant marine. Backed by his experience in South Africa, he was immediately accepted as a volunteer in the famous regiment. October 14th found the Princess Pats in Plymouth Sound, England, and after a brief period of training in English camps the regiment moved to France with the 80th Brigade of the 27th Division of the "Old Contemptibles," to take their place in a line desperately assailed and very thinly defended.

During these early days, food was scarce and the men suffered terrible privations. Urqhuart "enjoyed" a Christmas dinner of two biscuits and a small tin of beef and, with four others, spent the night in a poultry house. His brigade suffered most of all on account of the bitter cold, the feet of hundreds of men becoming swollen and bursting due to frostbite. Through January and February of 1915, the conditions were frightful. Heavy, continuous rains filled up the shallow ditches which were used as trenches and the troops were forced to stand in the icy water more than once for as long as 72 hours at a stretch. The British Government sent over thousands of tins of vaseline with which the men greased their shoes as a slight protection against the water. The more ingenious of the men punched holes in the end of some of the tins and drew a cord thru, so that, when lighted, the tins of vaseline acted as lamps, burning for hours. The small flame also helped keep the hands of the men warm enough to enable them to use their rifles and bayonets.

Late in February, 1915, Urqhuart's battalion moved into position at Shelly Farm, near the village of St. Eloi, occupying the famous Trench 21, only 30 feet from the German lines. The Germans had completed a sap which, added to their heavy bombardment of hand grenades, made the position of the Canadians extremely precarious. Consequently a party of 14 men, without any preparation or support from the artillery, attacked and demolished the enemy parapet for a considerable distance, killing every man in the German trench. About this time, Urqhuart had one of the narrowest escapes of his career. A particular friend, Paddy O'Connell by name, invited Urqhuart over to inspect the "palatial" little rest shelter which he had just completed. A little later, upon returning to his own shelter, just large enough for him to lie down in, Urqhuart found the shelter cut squarely in two by a shell fragment which had exploded at the spot where he had been lying.

On March 1st the Germans began a counter-attack. At 9 o'clock on the night of the attack Urqhuart received a bullet in his shoulder, and after hours of exposure under a terrific bombardment, he was removed from the trenches at 4:30 on the morning of the 2nd and transferred to the field dressing station at Voormezelle. So urgent was the need for men to replace the casualties that Urqhuart was back in action with his regiment on March 15th with his wound barely healed.

THE FIRST GAS ATTACK—APRIL 23, 1915

On March 20th the battalion sustained a severe blow in the death of its leader, Colonel Farquhar, and retired to rest billets. On April 9th it took up the front line on the extreme point of Hill 60 in Polygon Wood, along the Ypres salient. The British lines at this point were in the form of a narrow-necked bottle, with the Princess Pats at the "cork" of the bottle. The main Canadian division was on the immediate left, supported by French Turcos and Zouaves on the farther left. The British were on the right. At 5 o'clock on the morning of April 23rd, the Germans launched their first attack of asphyxiating gas. The French gave way, the gap immediately being filled by the Canadians who, in the face of all but complete annihilation, held their lines in one of the most immortal stands of the war. Fortunately, the Princess Pats were on the edge of the gas cloud and their casualties were not as heavy as those of the Canadians on their left. Urqhuart was gassed slightly, but was not out of action at any time. During the next ten days the Germans shelled the narrow neck of the "bottle," cutting off all supply trains going in to the Princess Pats. With practically nothing to eat and with no water except the scanty supply obtained from shell-holes, the suffering of the men was intense.

On May 4th the regiment took up a new line, some distance in the rear. About three o'clock in the morning, the Germans came over the hill in a strong attack and "dug in" at a distance of 700 yards. This attack was repulsed after the Germans had suffered severe losses but was followed by a heavy bombardment throughout the day. Ammunition was very scarce with the British at this time, *each gun being allowed only one shell per day.* The Germans had an abundance of shells and were sending over 50 to 100 to each one of the British.

That night the regiment was relieved by the King's Shropshire Light Infantry, and Urqhuart went into reserve trenches for 48 hours. Just after dark on May 7th, the battalion went back into the line and, in turn, relieved the 2nd King's Shropshire Light Infantry, who had lost 380 dead and wounded. A heavy bombardment followed throughout the night and all the following day and, on the night of the 7th, the roll call showed the strength of Urqhuart's battalion as 635.

The Germans started a very heavy bombardment the morning of the 8th, and the long day that followed was the most critical and costly in the history of the battalion. Every available man, including the cooks, was placed in the trenches. The German shelling was terrific and extremely accurate. Machine guns were buried, only to be dug out and used again. Both the fire and support trenches were repeatedly blown to pieces. At 11:30 that night, Urqhuart's battalion was relieved by the 3rd King's Rifle Corps, and marched back to reserve trenches. Out of the entire battalion there remained four officers and 140 men. Urqhuart had not received a scratch. Within a few minutes, however, following the news that their comrades were being hard pressed, the Princess Pats immediately volunteered and went back into the line.

On May 13th, the Princess Patricias formed a composite battalion with the 4th King's Royal Rifles and relieved the hard-pressed 4th Rifle Brigade. At the beginning of June, the battalion took up a new line at Armentieres and remained there until the end of August. Early in June, the Germans put up a large sign on their parapet stating that the Lusitania had been sunk. The British replied with a similar sign announcing the German loss of German East Africa.

Urqhuart had an interesting experience just at this time. One morning he met a fellow Princess Pat who was entering the line with his hat full of strawberries. Upon inquiry, Urqhuart found the patch was but a few feet away on the top of the parapet, the trench having been cut directly through it. Crawling on his hands and knees, and in momentary danger of being shot, Urqhuart managed to reach the coveted patch, where by lying flat on his back, he ate his fill of the berries. For several days thereafter, he enjoyed the daily luxury of strawberries for breakfast.

On July 15th Urqhuart received a fragment of a shell in the hip, and as a result was out of action again for several weeks. About the middle of September, 1915, the battalion moved with the 27th Division to a new line held by the 3rd Army in the South. Later, the 27th Division was withdrawn from this sector and the Princess Pats were detailed to assist in the training of the troops coming in as replacements for the 3rd Army, later joining the Canadian Division.

URQHUART RETURNS TO THE STATES

In November, 1915, the Princess Pats played a prominent part in the desperate fighting around Freis on the Somme. Here, on November 15th, Urqhuart was severely gassed and, at the same time, was struck by a piece of shell which inflicted a deep gash just above his left eye. He rapidly recovered from the shock of his wound and was again back in the trenches on December 6th. On January 15, 1916, he was again wounded during action in Belgium, this time in the hand. The continued exposure to which he had been subjected throughout the unfaltering and persistent campaigns of 1914 and 1915, combined with his continued but vain efforts to overcome the insidious effects of the gas, finally resulted in Urqhuart being declared physically unfit for further service. In November, 1917, he received his discharge, and was sent back to Ottawa, Canada, where he had enlisted.

Months of convalescence followed. Then Urqhuart went on a speaking tour, helping out on patriotic drives. He toured through New York and New Jersey, assisting in the 3rd, 4th, and 5th Liberty Loans. His first experience was at Rome, New York, where a record was made in the War Chest drive there. On October 15th, 1918, he arrived in Cleveland, where, through a former New York friend, he was introduced to Mr. P. J. Pritchard, manager of the Nela Lamp Division of the National Lamp Works. A talk with Mr. Pritchard resulted in Urqhuart's deciding to enter the X-Ray Tube Division, at Nela, for work on X-Ray tubes for hospital service for the army.

Through the courtesy of the National Lamp Works, and at the request of Mr. Henry Rogers of the Edison Lamp Works, Urqhuart was released on November 9th, 1918 for another two-weeks' speaking tour through New York and New Jersey on the United War Work campaign, returning on November 24th. When the work on X-Ray tubes was ordered discontinued, following the signing of the armistice, Urqhuart was transferred to one of the regular departments of Nela Lamp Division.

His was the satisfaction of knowing that he contributed to the downfall of militarism in at least three different ways: first, he fought through some of the most crucial battles of the entire war, receiving four wounds and being gassed twice, the later gassing so affecting his lungs that he could never completely regain his health; second, while with the National Lamp Works, he was doing what he could to save the lives of other heroes by his work on X-Ray tubes; and third, he stimulated the raising of money for patriotic purposes by telling civilian audiences what war really means to the soldier.

THE WAR ACTIVITIES OF NELA RESEARCH LABORATORY

On March 21, 1917, two weeks prior to the declaration of war, the services of Nela Research Laboratory were offered to the United States Government in the terms of the following letter addressed to the Secretary of War.

NELA RESEARCH LABORATORY

OFFICE OF DIRECTOR

March 21, 1917.

Honorable Newton D. Baker,
Secretary of War,
Washington, D. C.

My dear Mr. Baker:

The international conflict into which, it would seem, the United States may soon be forced, if it is not already a participant in fact, is a war founded largely upon science and engineering. I am deeply in sympathy with the administrative procedure of our Government in convassing the scientific and engineering resources of this country in order that the available facilities may be duly organized.

It therefore gives me pleasure, upon the authority of the Managers of the National Lamp Works of General Electric Company, to extend to the United States Government the facilities of Nela Research Laboratory for whatever uses it may be fitted, if in the event of war or in the pursuance of an intensive program of preparedness the Government may deem it advisable to avail itself of the services which this Laboratory may be able to render.

The Laboratory is particularly qualified to investigate problems in lighting, having a staff comprising several physicists, a physiologist, a psychologist and several men with engineering training. Its equipment, though developed primarily for the investigation of problems in its special field of inquiry, is nevertheless sufficiently general to permit of much broader application. The facilities of the Laboratory include a well organized scientific and technical library and a well-equipped instrument shop.

I would be glad to have you transmit this letter, or a copy of it, to such other Department or Departments of the Government as your judgment may determine.

Very truly yours,

(Signed) Edward P. Hyde.

Mr. Baker expressed his appreciation of this offer and stated that the facilities of the Laboratory would be used as required. In July, 1917, the National Research Council through Major Millikan requested the Laboratory to undertake an investigation of the relative merits of binocular and monocular field-glasses. The following letter indicates the importance of the problem in the war program:

NATIONAL RESEARCH COUNCIL
ACTING AS THE
DEPARTMENT OF SCIENCE AND RESEARCH
OF THE
COUNCIL OF NATIONAL DEFENSE

July 30, 1917.

Dr. E. P. Hyde,
Nela Research Laboratory,
Nela Park, Cleveland, Ohio.

Dear Dr. Hyde:

I had sent to you yesterday from the Navy Department two binoculars, one of five-power and the other of ten-power, of the sort which they use in the Navy. I think Dr. Mendenhall also had some of the Army binoculars sent to you. This question of binoculars versus monoculars is one which I raised in the Munitions Board some weeks ago, and the General Staff of the Army asked to have the matter carefully investigated and reported upon. What they want

> is advice as to whether there really is any advantage in binoculars. The report comes that the Germans have discarded binoculars for monoculars. I do not know how correct that report is, but I know of no place in the country to which we can look for more well founded judgment upon a subject which involves physics, psychology and physiology than your Laboratory. I shall be glad to present your findings to the Munitions Board, and I am sure the General Staff will be much interested in it.
>
> Very sincerely yours,
> (Signed) R. A. Millikan.

THE INVESTIGATION TO DETERMINE WHETHER BINOCULAR FIELD-GLASSES MIGHT BE DISPLACED BY MONOCULARS WITHOUT APPRECIABLE SACRIFICE OF EFFICIENCY

In pursuance of the request from the National Research Council, this investigation was begun immediately. The greater part of the experimental work was carried out by Dr. P. W. Cobb and Dr. W. Weniger. The problem, the methods of investigation pursued, and the conclusions reached, are briefly outlined in the following paragraphs. It may be well to mention that, inasmuch as this work was of a purely research nature, the use of technical words cannot be entirely avoided.

How the Field-Glass Increases the Range of the Eye

Monocular vision is the vision pertaining to the use of only one eye, while binocular vision pertains to the use of both eyes. The effect of monocular vision may be easily seen. If two similar objects, one slightly farther away from the observer than the other, are seen with only one eye, it will be very hard, if not impossible, to distinguish which object is the closer. If, however, one looks at the same objects, using both eyes, no such difficulty will be experienced.

Consequently, if the average person were asked to compare monocular with binocular vision, he would probably dismiss the whole matter with some such remark as this, "Of course binocular vision is better, because we can see the depth of things." But there were many other things to be considered such as cost, ability to distinguish detail, etc. This matter of seeing depth or relief is very vividly impressed upon the mind of anyone who has used an ordinary stereoscope. The stereoscope is nothing more nor less than an optical instrument having two eye-pieces which, when the instrument is used by an observer, serve to combine the images of two pictures taken from points of view a little distance apart into one magnified image,—thus giving the effect of depth.

The reason why one can see stereoscopically is because each eye looks at any object from a slightly different position, thus making the images slightly different. A receding edge of the object, for example, subtends a slightly different angle at each eye, and it is the difference between these two angles which measures the amount of the so-called "binocular parallax" and determines the amount of depth or relief that is perceived. The cause of this "binocular parallax" may be realized if the reader will look out of a window, first with one eye and then with the other, and note the difference in the apparent relative positions of the trees, etc., on the window pane. It is evident that the difference between these two angles subtended at the eye will be much greater when a certain object is looked at from near at hand than when viewed from a distance. In other words, the stereoscopic effect diminishes rather rapidly with distance from the observer. When the difference between the two angles becomes of the order of magnitude of 30 seconds of arc, *i. e.*, $\frac{1}{120}$ of a degree, most people can no longer perceive it, and stereoscopic vision ceases.

It is evident, then, that if objects are to be seen at any great distances, say several miles, with the same clearness and depth of vision as are objects close at hand, the binocular parallax must be increased so as to keep it above the minimum value of 30 seconds of arc at which the stereoscopic effect may be noticed. When the eyes are aided by field-glasses, the binocular parallax may be increased in two ways; by magnification and by increasing the effective distance between the eyes, that is, by placing the objective lenses farther apart than the eye-pieces, as is done in most types of prism binoculars. This increase in the distance between the objective lenses increases the difference between the angles which an object subtends at the eye; in other words the binocular parallax is increased, as was desired. Then, since it is possible to keep the parallax down to 30 seconds of arc and still gain the depth of vision desired, the distance from the eye to the object may be increased. For the Type EE 6-power prism binocular that has been adopted by the army, the distance between the objective lenses, generally known as the "interobjective" distance, is about 1¾ times as great as the distance between the eyes, *i. e.*, the "interpupillary" distance. If an interpupillary distance of 2.56 inches (65 mm.) is assumed as applicable to the average observer, the use of such a prism binocular would give an interobjective distance of 1¾ times 2.56 or 4.48 inches, and a simple calculation shows that a point at a distance of 5100 yards, or 2.9 miles, from the observer can just be distinguished by him as nearer than the infinitely distant horizon. In other words, the range of the glass is at the point where stereoscopic vision ceases which, in this case, is at a distance of 2.9 miles from the observer.

The Problems Involved in the Study of Parallax

The Sub-Committee on Monocular and Binocular Field-Glasses was interested in determining how this matter of parallax would affect vision. The objects that must be observed are, of course, of many different kinds, and the illumination of these objects varies widely, so that there will be under observation objects differing in size, in brightness, in color, in their state of motion or of rest, etc. Apparatus was therefore designed to study the effect of parallax on the perception of these different qualities, but it was also decided that experimental work must begin upon a still more simple problem, namely that of the comparison of monocular and binocular acuity upon a flat field, where the question of parallax does not enter at all.

It is evident that in any problem of this kind a very large number of experiments must be performed in order to strike a proper average. In addi-

In Center, Administration Building
At right, Nela Research Laboratory

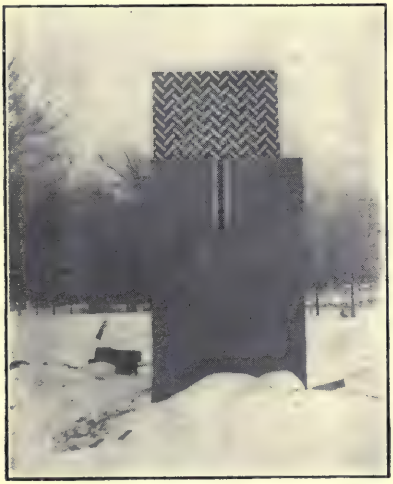


Fig. 1—Test Object and Observer's Station at Mayfield Country Club, where early experimental work on Field-glasses took place

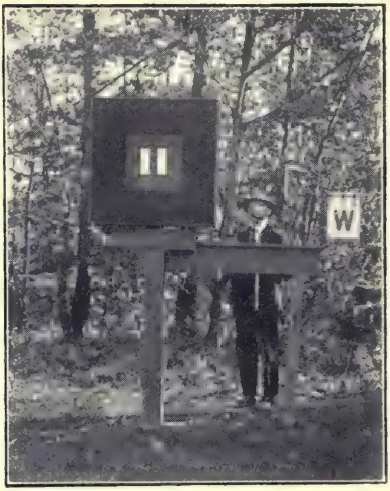


Fig. 2—Background and Test Object used in determining effect of Stereoscopic Vision on discrimination of detail

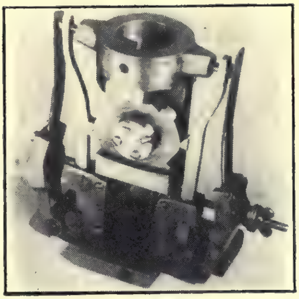


Fig. 4—Machine Designed for making Ribbon Filament for Signal Lamps

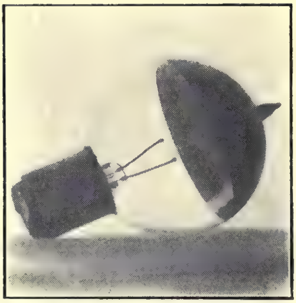


Fig. 5—Silvered-Bowl Lamp employing a Ribbon Filament

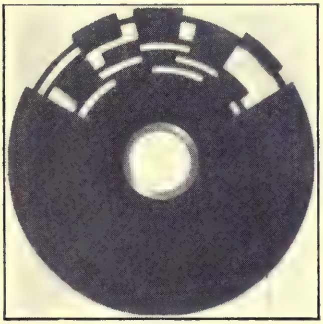


Fig. 6—Sectored Disk, rotated to give "dots" and "dashes" of light

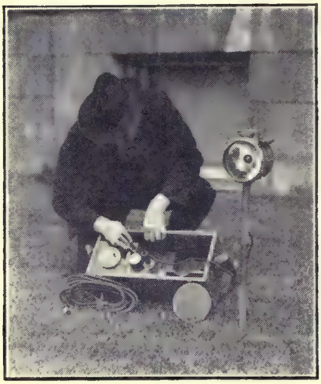


Fig. 7—Trench Signalling Unit in operation

Fig. 3—Observation Field at Camp Meade, Md., where Nela Research Laboratory ran tests to determine relative advantages of Binocular and Monocular Field-glasses.

tion to such factors as attention, fatigue, different physical condition of the observers on different days, practice effect, and the like, which are present even under laboratory conditions, there are present out of doors many other disturbing factors. Among these may be mentioned a different amount of heat shimmer from hour to hour; a difference in the illumination of the test object due to position of sun and clouds; different sky brightnesses; clear, smoky, and hazy atmospheric conditions; rain and snow; different temperatures, from hot to such extreme cold as to stiffen the fingers; and variable winds, which may make it almost impossible to stand still long enough to make an observation or which, by blowing between the eye-piece and the eye, may cause the tears to flow.

The Beginning of the Work on Field-Glasses

The first experimental work was done on the grounds of the Mayfield Country Club, to whose Directors the Laboratory was greatly indebted for the many conveniences placed at the disposal of the experimenters and the many courtesies accorded them. A "test object," shown in Fig. 1, presenting the appearance of a white square with a black strip equal to one-third its area extending down its center, was mounted at a distance of 1040 yards from the observer. The test object was viewed against a black background, was variable in size and could be rotated so that the black strip was either vertical or horizontal. The size and position of the test object was varied according to a pre-arranged helter-skelter order, and the observer reported whether the strip was vertical, horizontal or too small to see. The time required to arrive at a decision was taken with a stop-watch.

About 500 experiments were made on each of three observers to eliminate practice effect, and then 1200 more upon which the following statements are based. No decisive advantage was found in the use of the two eyes together over the better eye alone; in one case the use of the two eyes gave results about 4% poorer than the use of the better eye alone. Note the conditions of the experiments that lead to these results; flat field, no stereoscopic vision, maximal contrast (black and white), out-of-door conditions, and trained observers. The two eyes of each observer (one supplied with spectacles) differed from each other by an amount less than that detected by the usual optometric methods. Steadiness of holding, and muscular comfort or discomfort while using either the monocular or binocular were identical, as the monocular results were obtained by merely putting a ground-glass cap over one limb of the binocular. Both eyes were kept open all of the time so as to eliminate the muscular fatigue that results when one eye is closed, as well as to keep both pupils of the same diameter as nearly as possible.

It is of interest to mention that the above results were in entire harmony with the experience of a great number of users of field-glasses, including one noted astronomer and one manufacturer of binoculars. One colonel of Field Artillery, upon being told the above result, volunteered the information that whenever he got through "observing fire" with a pair of binoculars, he invariably found he had closed one of his eyes; that is, he involuntarily worked monocularly, at least in the final stages of an observation.

It is well known that the eyes function differently in very low and in ordinary illuminations. The retina has two different types of light-sensitive organs, called respectively the "rods" and "cones." The rods exist in the peripheral retina, and are extremely sensitive to weak illumination. The cones are most numerous in the small area of the retina known as the "fovea," upon which the lens and other eye media form the image; they are sensitive to color, but not as sensitive to weak illumination as are the rods. The absence of the rods in the fovea causes what everyone has noticed, namely that in twilight the outlines of an object appear indistinct, and seem to vanish the instant you try to look sharply.

The Results Obtained Under Twilight Conditions of Operation

As twilight is an important illumination for military operations, it was decided to repeat the acuity work under weak illumination. Twilight in nature is of rather short duration and of very rapidly changing intensity, making the use of artificial twilight imperative in any experimental investigation. Continuous out-of-door observation was impossible on account of the extremely severe winter that had set in at Cleveland by this time. Fortunately, one of the long pipe-tunnels at Nela Park was available for this work, so that a sufficiently large distance (about 89 yards) could be obtained to enable the use of the same binocular without the excessive convergence of the eyes that of necessity exists at short distances. The same test object and the same method was used as before; however, one new observer had to be trained to replace one man who had been drafted. The artificial twilight was produced by projecting the radiation from a MAZDA lamp filtered through a piece of "daylight glass" upon the test object so as to produce an illumination of only 0.0012 foot-candle.

After the customary practice runs, each of three observers made about 1200 experiments that yielded the following conclusions:

1. With binocular observation the "threshold of vision" is somewhat lower than with monocular observation using the better one of the two eyes;
2. When the test object is of such size that the judgments are preponderantly correct, the decision of the observer is arrived at in shorter time with the binocular; and
3. With sizes of the test object such that both right and indeterminate judgments appear in large numbers, the tendency is to spend more time in binocular than in monocular observation.

The illumination selected was such that rod vision was used. An object just resolvable in this twilight illumination was 15.6 times as large as one just resolvable in average daylight, or to put it another way, an object seen with a six-power glass in this twilight was not less than 2.6 times as large as one seen with the unaided eye in daylight. Hence if objects of the same size are to be examined or located in both daylight and twilight, different optical aids are desirable in the two cases.

The Tests for Discrimination of Detail

The preceding preliminary work gave the preparation necessary to take up the simplest of the problems involving stereoscopic vision, and apparatus was built for determining the effect of the presence or absence of stereoscopic vision on the discrimination of detail. Two backgrounds (Fig. 2) were placed at a distance of 375 yards and 445 yards from the observer, the nearer one being removable. Both were painted with a herringbone pattern in white on a black ground, the stripes being easily resolvable through a six-power glass. The dimensions of the backgrounds and of the patterns were in direct proportion to their distances from the observer, so that the images of the patterns as received in the observer's eyes were identical. A test object consisting of two vertical strips of variable width, painted with the same proportion of white and black as the backgrounds, was placed one yard in front of the nearer background. The strip exposed, and its size, were changed in shuffled order, and the observer reported which one he saw or that he saw neither. The time taken by him to arrive at a decision was measured with a stop-watch. Observations were made with both eyes and with the better eye only, using both backgrounds; the farther one, of course, was the only one against which the strips showed binocular parallax.

Unfortunately the necessary practice runs had not yet been completed when the work was stopped to carry out a field test under the supervision of army officers. The work was not resumed at the conclusion of the field tests because three of the four observers who had been training on this problem were no longer available, all having entered the army. The practice runs, however, showed clearly that there is no very large difference in the detail that can be detected with or without the aid of binocular parallax, nor in that seen with the better eye or with two.

Apparatus for the study of the effect of binocular parallax on the discrimination of brightness differences was planned but not constructed when one of the Committee members was commissioned in the Sanitary Corps.

The Field Tests at Camp Meade

The field tests were carried out at Camp Meade, Md., in March, 1918, under the immediate supervision of the Board to Test Snipers' Materials. The tests were designed with the active assistance of all members of the Board, and of as many other officers having opinions on the subject as the Committee would get in touch with. The desire was to establish tests that would cover the important points met in actual service in such a manner that army men would regard the results with confidence.

These tests differed from the preceding in many ways.

First, the binoculars were Bausch & Lomb type EE, adopted by the army as standard. The monoculars were exactly like the right-hand limb of the binoculars. Conditions of stability of holding the two types therefore differed, even though explicit directions were given in each case as to the proper method of holding.

Second, the observers (Fig. 3), about 50 in number, were all army officers, lieutenants and captains, but unfortunately the group was not exactly the same on all days. All had had some experience with binoculars, but practically none with monoculars. Very few were really trained observers, and as it was impracticable to extend the tests so as to train them, all results obtained had to be included in the averages. In using the monoculars, either eye, and not necessarily the better one of the two, was used. The instructions given as to the proper holding of the glasses were not strictly obeyed at the beginning of the tests, especially those instructions which pertained both to holding the glass in the left hand when using the right eye, or *vice versa* (in order that the wrist of one arm might be before the unused eye), and to keeping the unused eye open. It was sought to impress upon the observers that this was a test of a certain type of instrument and not in any manner a test of men; that is, that a poor percentage of correct answers would in no wise reflect upon them as individuals; but in spite of this, at the beginning, some communication existed.

Third, the test objects were, for the most part, men in khaki. They thus presented varying amounts of color contrast, of brightness contrast, and of stereoscopic relief against their backgrounds.

In the first test, eleven men were stationed in hiding at definite positions ranging from 410 to 1850 yards from the observers. According to a prearranged schedule these men appeared from behind trees, rose from trenches, showed themselves in the windows of a house, etc., for 50 seconds, then raised an arm to the level of the shoulder or aimed a rifle, and went into hiding again. The observers had to watch the entire field, pick up the man who happened to be showing himself at that time, watch what he did, and record which arm he raised or in which direction he aimed his gun. This test was run on four different days, each man using both the monocular and binocular for the same number of experiments each day. A total number of 7174 experiments was considered for each type of glass. In order that all the results might be combined, a system of weights was devised for the different stations at which the men appeared, based upon the total records for all four days.

The Relative Advantages of Both Binoculars and Monoculars

The results show a consistent, though slight, superiority for the binocular. In the matter of "picking up" or locating a man, the binocular ran about 5% ahead of the monocular on the first day, but the difference decreased to about 3% on the fourth day, averaging 3.8%. In the matter of distinguishing detail, that is, of telling whether an arm or a gun was raised, and in which direction, the difference was a little less than 8% and did not show improvement with practice. This result was not conclusive, however, because, as above mentioned, the better and poorer eyes were used indiscriminately with the monocular. The Mayfield Club experiments also showed that binocular acuity is somewhat greater than the mean of the acuities of the two eyes.

The man at one of the stations arose from a trench and was exposed against a distant background, thus affording an abundance of stereoscopic relief. This man was seen 3.7% more frequently with the binoculars than was an average of all the other men, who afforded no stereoscopic relief, but he was also seen 3.7% more frequently with the monoculars. Whether the act of raising his arm or his rifle was to the right or the left, was detected with the binoculars 8.8% more frequently than for an average of all other stations, and 7.9% more frequently with the monocular. For distinguishing between an arm and a rifle, the corresponding figures were 11.6% for the binocular and 8.8% for the monocular, so that the indication was that stereoscopic effect is a distinct advantage for binocular discrimination, but it must also be emphasized that this advantage may be due to other causes that have not yet been studied in isolation, such as the comparative discrimination of small brightness differences, the detection of motion and in general the part played by the peripheral retina.

The same series of experiments was carried on for two days during the waning light of late afternoon. The data were meagre but showed the binoculars to be slightly better. The difference in favor of the binoculars is much smaller in this work than in the tunnel work, probably because the illumination out of doors was such as to allow a visibility about three times that in the tunnel.

On each of two days, one hazy and dark, the other bright and clear, so-called counting tests were made. From 7 to 11 men appeared from each of three different hiding places at distances from 1190 to 1800 yards, and remained in sight for 10 seconds. On both days, for the binocular, the number of correct counts was larger by more than 5% and the number of large errors smaller.

Time Test on Both Types of Glasses

On two different days the men who ordinarily acted as test objects, became observers in certain timing tests. Two parallel black strips mounted on a white board were exposed either vertically or horizontally, in shuffled order, at a distance sufficiently great so that they could not be resolved with the unaided eyes. The glasses were focused, the binocular being put in its case and the monocular in a coat pocket with the flap buttoned. At a signal, the glass was removed, brought to the eye and the position of the strips announced. One stop-watch was started at the signal, another when the glass came to the eye, and both were stopped when the position was announced. From 1.5 to 2.0 seconds more were consumed in the delay incidental to getting the binocular to the eyes from its carrying place than were similarly required to get the monocular into action but, once at the eyes, the binocular enabled the user to report in 0.32 to 0.44 seconds less time than the monocular.

These field tests, carried out for a very limited time with not particularly trained observers, showed for each condition that for these men vision was better with the binocular. The advantages found were not, in point of magnitude however, of sweeping moment. At the maximum the difference in discrimination of detail amounted to a little more than 12% of the number of experiments. If one of the results of the Mayfield Club tests is taken, *i. e.*, that roughly 25% difference in frequency of correct answers corresponds to 9% difference in size, the size-difference corresponding to 12% frequency-difference is a trifle less than 4.5%. It is then a safe theoretical conclusion that an increase of 4.5% in magnification (6.27 instead of 6.00) would offset the relative disadvantage of the monocular in the most unfavorable case of daylight illumination. Tests carried out with binoculars for a period of several years by a certain branch of the army showed conclusively that a magnification of 8 was best. A magnification of 6 was adopted as standard. This sacrifice was presumably made to reduce weight or expense or for some other similar reasons.

Moreover, at the time of the completion of these tests there was a scarcity of optical glass in this country as well as a scarcity of skilled workmen. It takes approximately three times as long to make a binocular as a monocular, and of course the glass required is twice as much. *The complete investigation indicated that for most classes of field work, the monocular field-glasses might replace the binocular field-glasses without any appreciable loss in efficiency, but with a very great economy in the time of mechanics and in materials used in the construction of field-glasses.*

The evaluation of this work by Lt. Col. Millikan is indicated in the following letter:

NATIONAL RESEARCH COUNCIL
ACTING AS THE
DEPARTMENT OF SCIENCE AND RESEARCH
OF THE
COUNCIL OF NATIONAL DEFENSE

June 13, 1918.

Dr. Edward P. Hyde,
Nela Research Laboratory,

Dear Dr. Hyde:

This is to acknowledge the receipt of your very full report on Binoculars vs. Monoculars. I regard this as one of the most important pieces of work which has been done at all in the aid of the war, and I think it likely that on the basis of this report monoculars will be put into production at once. I will let you know as soon as a decision is made.

. . . .

. . . .

Sincerely yours,
(Signed) R. A. MILLIKAN,
Lt. Col. Signal Corps.

For some reason, however, the General Staff disapproved the recommendations and binoculars continued to be furnished to army officers during the remaining months of the war.

The Work on Light-Signalling Units

Early in 1918 the Laboratory was asked to develop an artificial-light unit for signalling in the daytime in places where the operator would be seen against a bright sky background. Later an additional request came for a 6-volt, 2-ampere lamp for use in a trench-signalling unit designed by Major Mendenhall and the Lynn Works of General Electric Company, to supplant the unsatisfactory unit then in service. Practically the entire time of Drs. Forsythe, Lorenz and Worthing was given for a period of ten or twelve months to working out these problems in light-signalling.

During the war at least three methods of signalling employing incandescent lamps in parabolic reflectors were developed and used in the various armies. In one method the dots, dashes and spaces of the International Telegraphic Code were produced by operating a shutter in front of the signalling unit, much as did the Indian who waved his blanket before his signal fire. In a second method, the flashes were produced by slightly tilting the mirror back and forth, the effect on a distant observer being the same as though the beam had been actually interrupted. In the third method the signals resulted from the making and breaking of the electric current through the lamp. In warfare, portability of instrument and supplies are of prime importance; therefore, considerations of efficiency rule out the first two methods in case the third is at all applicable.

The expensiveness of the electric energy supplied by dry cells as used in trench-signalling work (which increased the national debt at an average rate of $50.00 to $100.00 per kilowatt-hour, in contrast with ten cents or less, the price for electricity as used in homes) made it very desirable to find some method of cutting down the consumption of energy per outfit.

The Use of A "Ribbon" Filament

In a preliminary consideration of the problem it was decided that the most probable solution might be expected from the use of a ribbon filament (rather than the wire filament of ordinary lamps) of tungsten in an argon atmosphere. These specifications were based on the following principles which, when embodied in a lamp, should tend to make satisfactory and workable the third method of light-signalling which depends upon current interruptions in the lamp. Properties tending toward rapidity in flashing, (*i. e.*, shortness of the time-intervals required by the filament in heating to its maximum brightness, and later in cooling down to darkness) are: first, the high positive temperature coefficient of tungsten which results in a greatly increased rate of supply of heat to the filament; and second, the ribbon form with its inherently small amount of material to be heated and cooled, for a given radiating surface. A third factor, one tending toward economy in usage of batteries, is the high efficiency of lamps with filaments in an argon atmosphere.

The division of labor accompanying the development work naturally fell into three subdivisions:

(1) The production of a ribbon filament;

(2) The determination of the characteristics of the completed unit which make for efficiency;

(3) The determination of the favorable conditions and the attainable speeds of operation for the completed unit.

In fulfilment of a small ante-war demand for ribbon filaments, wire filaments had been hot rolled. The product was either in the form of sheets or of such thickness as to be of little use for signal lamps. Attempts to obtain ribbon filaments of the desired dimensions by rolling resulted in poor quality for both ribbon and rollers. Under the stimulus of war-time needs, many ribbon-making possibilities were considered. The plan finally carried through consisted of a continuous hammering process, in which two hammers coming from opposite directions strike the wire simultaneously. How this was accomplished may be understood with the aid of Figure 4. The rotation of the notched hardened-steel disk or cam alternately pushes apart and releases the two oppositely placed spring-adjusted hammers, likewise of hardened steel, which are pinioned firmly at their lower ends. A wire slowly passing through the hammering chamber at the top, between the hammer heads, is subjected to a rapid succession of taps. In making the ribbon for the signal lamp a speed of 800 taps per minute was found suitable. The hammering chamber was completely enclosed and filled with hydrogen so that the tungsten wire could be heated electrically, without deterioration, to temperatures which facilitated the ribbon-making process. This hammering process resulted in very satisfactory ribbon filaments for signal lamps (Figure 5). In fact, excellent ribbon as thin as one or two thousandths of a millimeter was obtained. (A millimeter is about one twenty-fifth of an inch.)

The Tests of the Lamp In searching for the best 6-volt, 2-ampere lamp for use in the trench-signalling unit, many types of lamps containing variously shaped filaments of tungsten wire or ribbon, immersed in atmospheres either of nitrogen, argon, or hydrogen, were considered. Various tests were made, some from the viewpoint of speed of operation, others from the viewpoint of economy in battery usage. Only one of each type will be considered.

For the test relating to the speed of flashing, instantaneous candlepower measurements were made, in which the observer obtained glimpses only a hundredth of a second in duration. By suitably choosing various instants following the beginning of a flash for these measurements, the relative changes in brightness of a signal lamp could be followed. Performance curves were obtained for various lamps, showing how the brightness increased to the maximum steady value on heating up and decreased again on cooling down. The contrast here given is only between the two lamps from which the final choice for the trench-signalling unit was made; one, a ribbon filament in argon; the other, a wire filament in nitrogen, which was the gas considered necessary for sufficient speed in that case with a wire filament. It was found that the *ribbon-filament* lamp reached 95% of its maximum brightness in 0.07 second following the beginning of a flash and that it cooled down at the end of the flash to 5% of the maximum values in less than 0.03 second. The time required by the *wire-filament* lamp on heating was about 50% greater, although the cooling time was of the same order as that for the ribbon-filament lamp. Evidently the ribbon form was an aid to speed.

The results of a test relating to economy in the usage of batteries were found of the greatest importance and applicable to all lamps. It showed how effectively the silvering of the tip end of the lamp, as in certain autoheadlight and spot-light units, conserves for the beam much of the light otherwise radiated scatteringly through the front opening of the unit. This silvering redirects much of this light in such a way that it can be utilized. For both of the lamps mentioned there was an increase of roughly 40% in the average beam intensity. *Considering that with the lamps unsilvered a 40% greater battery supply was necessary for the same beam intensities*, that is, for the same degree of probability that signals would reach the person signalled, *the plan of silvering saved greatly in cost and in transportation of material.*

How the International Code was Sent

In the third main subdivision of the work, relating to favorable conditions and attainable speeds in signalling, the first essential was a knowledge of the best distribution of light in the signal. Assuming the International Code, in which all spaces are equal, the problem became one of determining the allotment of time to dot, dash and space so that the entire signal might be perceived with certainty in the minimum of time. For this purpose, a special rotating sectored disk was devised. An opaque circular sheet of metal from which a large sector, about 120° in extent, had been cut away (Fig. 6) was mounted in front of a lamp and rotated. The lamp was alternately visible for one-third of a rotation, and invisible for two-thirds of a rotation. Further, a small opaque sector, from 40° to 50° in extent, was so mounted over the 120° opening in the main disk that the two open spaces were noticeably different. Rotation of the whole before the lamp resulted in the sending of two successive unequal flashes which could be identified as a dot and a dash.

The combination disk was initially mounted with some arbitrary allotment of time to dot, dash and space, and then rotated in such a way as to give a haphazard order, dot-dash and dash-dot signals, first at one speed and then at another, while an observer read and recorded the signals received. From a comparison of the signals sent and the observers' records, the greatest speed of reception of signals for the given allotment was noted. Repetition with other allotments of time to dot, dash and space naturally led to the best arrangement for the perception of the signal. As a matter of fact, lest the observer, knowing the particular signal, should supplement his observation by his imagination, several signals were actually used and the accuracy determined through the agreement between the actual signals given and the reported observations. After the experiment was completed and the results obtained for one observer, a second observer was introduced and the combined results were taken in arriving at the conclusion. It was found that the total signal could be given in the least time if the dot, dash and space bore to each other the ratio 1:4:3.

Tests with this arrangement of dot, dash and space, in which eight different signals were first presented in a haphazard order by means of a rotating sectored disk in front of a steady glowing lamp (Figure 7) and then by means of flashing on and off the ribbon-filament lamp, described above, showed very little difference, indicating that for the conditions of operation there was no need of changing the design of the lamp to make it operate faster. In other words, the determining factor in reading the signals seemed to be the eye rather than anything connected with the flashing lamp. Similar tests made using a lamp with a wire-filament of tungsten in nitrogen showed, in accordance with what has been said, slight differences in favor of the ribbon-filament in argon.

THE LIGHT-SIGNALLING UNIT IS ADOPTED AT WASHINGTON

The success of these experiments carried on at the National Lamp Works is indicated by the following letter from Major Mendenhall, supplemented by the subsequent order, after the signing of the armistice, for fifteen hundred 6-volt, 2-

ampere lamps containing a ribbon-filament with very open double-spiral winding immersed in argon for use in trench-signalling units.

WAR DEPARTMENT
BUREAU OF AIRCRAFT PRODUCTION
WASHINGTON

Science & Research Dept. 1023—16th St. N. W.

November 18, 1918.

Dr. E. P. Hyde,
Nela Research Laboratory,
Nela Park, Cleveland, Ohio.

My dear Dr. Hyde:—

The lamps which you referred to in your letter of November 14th came today, and we are very glad to get them. While the pressure for signalling devices has certainly abated, we are going ahead to put the devices which are under development into somewhat final shape, pending receipt of any orders to the contrary. Therefore, we were very glad to get these lamps for trial in the trench unit.

I am not quite clear from your letter as to whether the Nela Lamp Development Laboratory has stopped all of its efforts to develop a ribbon-filament lamp as a manufacturing proposition. I very much hope this is not so, because signalling lamps are certainly going to be used and I feel that the ribbon-filament is a distinct advance. Unless the problem is a long way from being solved, I hope that work can continue on it.

Yours faithfully,
(Signed) C. E. MENDENHALL,
Major, A. S., A. P.

THE WORK ON CAMOUFLAGE

Early in the war it became apparent to scientific men that the problems of visibility and of camouflage could be solved satisfactorily only by systematic investigation. This fact is worthy of note because of the popular idea that camouflage, especially, was an activity for the artist.

These phases of modern warfare were not, in any sense, new arts but they became highly developed through the application of the scientific knowledge of the present time, just as other activities of warfare were similarly influenced.

In the fall of 1917 the services of the laboratory were requested in connection with the army program on camouflage. This work was referred to Mr. Luckiesh, who initially visited Washington periodically and assisted as much as possible the Camouflage Units which were being mobilized at the

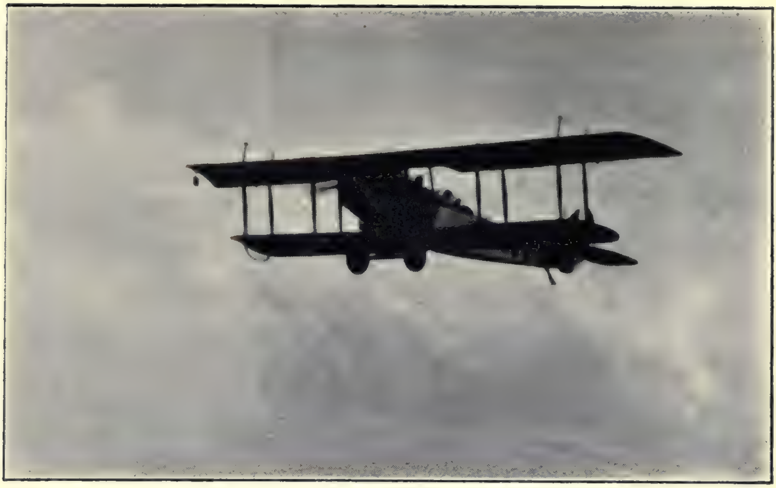


Fig. 8—An Airplane viewed against the sky. In spite of the fact that the plane is painted white, it appears very dark when silhouetted against the bright clouds and sky.

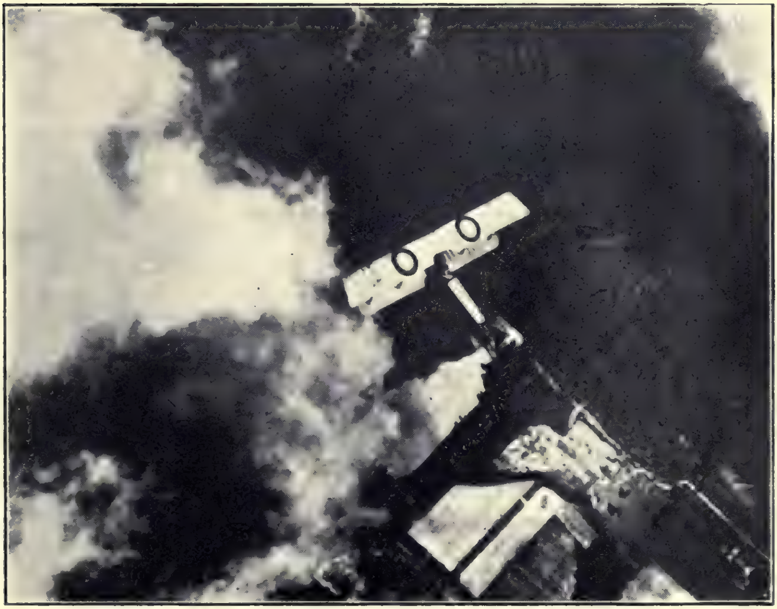


Fig. 9—Looking down on the Airplane from above. In this case, the earth is so much darker than the Plane, that the latter is seen as a bright object.

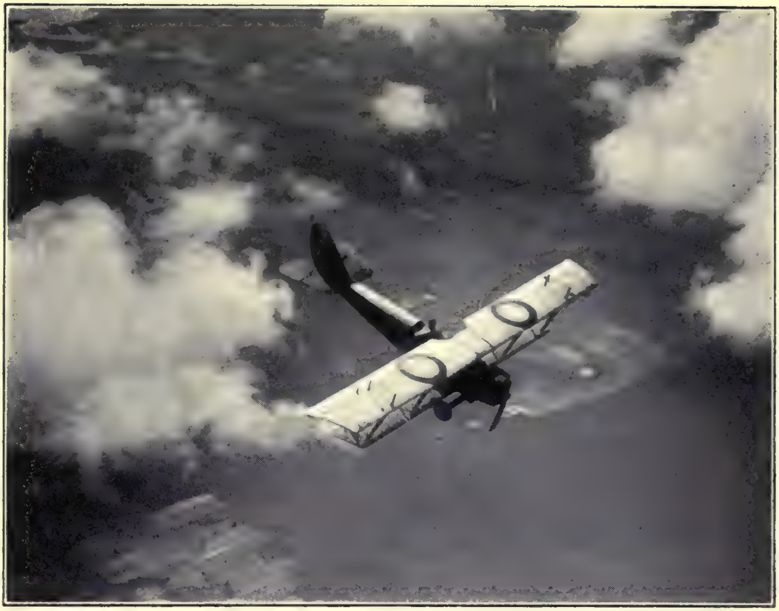


Fig. 10—Since an Airplane is a very small object when viewed at a few thousand feet, any pattern used to render it of low visibility should obviously cover a large portion of the wing surface.

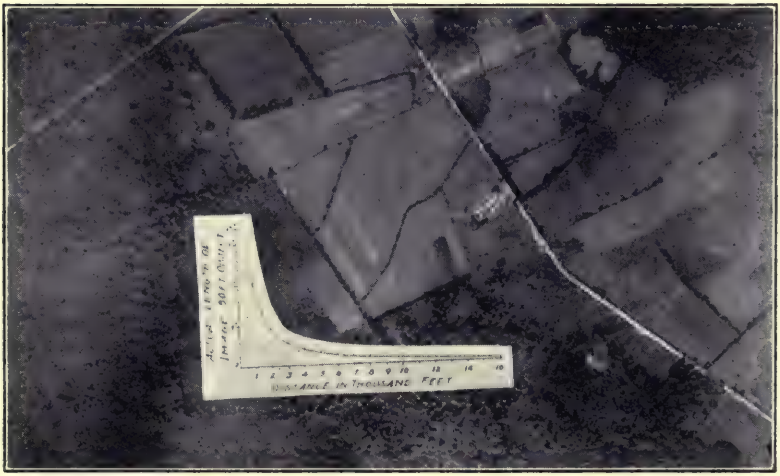

1 2 3 4 5 6 7 8 9 10 12 14 16
DISTANCE IN THOUSAND FEET

Fig. 11—Use of the Scale shown here enabled a Plane to be "placed" at any desired altitude and in the proper proportion. This assisted greatly in selecting the best pattern for camouflage.

American University. Subsequently, in order to obtain information and data that would be of value, he undertook the extended investigation of sky and earth brightnesses described in the following abstract. The work was conducted primarily for the Science and Research Division of the Bureau of Aircraft Production.

The Visibility of Airplanes

In order to make an object invisible, it is necessary to render it of the same appearance as the background. Hence it is necessary to obtain accurate data pertaining to the background, for, without such data, the problems must be solved by trial—a tedious and unsatisfactory method. While, of course, it is not possible in all cases to realize the ideal of complete invisibility, objects may be rendered very difficult to distinguish. If the background is constantly changing, however, the problem becomes much more difficult. For example, if an airplane viewed from above is provided with a pattern of certain colors and hues, it might be fairly inconspicuous when over a wooded area and yet be quite conspicuous over ploughed or barren land. It is quite obvious, therefore, that effective camouflage for craft operating under these conditions may be determined in the best manner, and shortest possible time by first obtaining data pertaining to the backgrounds. As a consequence of this reasoning and with a knowledge of the factors involved, a compact apparatus was devised which could be operated in aircraft and with the necessary measurements and observations for studying the conditions of camouflage could be made.

The program of study of airplane camouflage included two general viewpoints, namely, above and below the airplane. It is not practicable to render a craft of low visibility from above and below simultaneously, because the solutions are more or less opposed to each other. When viewed from underneath against a background of bright sky and clouds whose aspect changes from minute to minute, the aircraft is a dark object (Fig. 8). But when looking down on the airplane, the background is usually the much darker earth, whose aspect changes from season to season, and the airplane of natural finish is a bright object. (Fig. 9).

Obviously, the character of camouflage which is required will depend upon the type of airplane, such as bomber, patrol, scout plane, etc.; upon the height at which the various aerial operations are carried out; and upon various other characteristics of service.

THE VISIBILITY OF AN AIRPLANE VIEWED FROM ABOVE

Measurements of the reflection-factors of earth areas were made on a great many days, involving many hours of flying under various kinds of weather conditions. The mean reflection-factors obtained for various earth-areas during the summer were as follows:

Fields of growing crops	6.8 per cent.
Woods	4.3 per cent.
Barren land	13.0 per cent.
Shallow inland waters (rivers, harbors)	7.4 per cent.
Deep channel in Chesapeake Bay	4.9 per cent.
Atlantic Ocean, 50 miles from coast	3.5 per cent.
Dense cloud bank, as high as	78.0 per cent.

The surprising feature of these values is that they are generally much smaller than would be expected. This result is explained on the basis that, as seen from above, there is much shadow intermingled with the highlights. Any object, to be of low visibility when viewed against the earth, must be painted with very dark shades. These values were found not to differ materially in other seasons. The reflection-factor of fresh snow is about 80 per cent. That of barren land differs considerably with the character of the soil. Wet soil is much darker than adjacent dry soil.

Color in this particular problem is of less importance than brightness, and it was found that simple measurements reinforced by experience accounted for this phase of the problem satisfactorily.

The size of the pattern to be used in the camouflage aimed to render airplanes of low visibility as viewed from above is of more importance than the actual shape (Fig. 10). An airplane of 50-foot spread is a very small object when viewed at a few thousand feet; however, some slight pattern or mottling appears to be desirable. Pattern was studied photographically, series of photographs of the same terrain being made at altitudes from one thousand to twenty thousand feet. By knowing the dimensions of the optical system of the camera and those of an airplane, it was possible to calculate the size of the image of the object for various heights of the plane above the earth or, in other words, an airplane could be "placed" at any desired elevation above the earth by superposing an image of the proper size upon a photograph. This feature, shown in the accompanying illustration (Fig. 11)enabled the best pattern to be selected to obtain low visibility.

These data, with others of minor importance, made it possible to conclude the best compromise which would render aircraft of low visibility as viewed from above.

THE VISIBILITY OF AN AIRPLANE VIEWED FROM BELOW

The sky is now the background. Measurements of its brightness were made at various altitudes up to 20,000 feet. The earth-haze commonly extends to an elevation of about a mile, and above this point the sky decreases more slowly in brightness as the altitude increases than for the first mile. On extremely hazy days, the zenith sky was found to be only one-tenth as bright for an observer at 20,000 feet as it was when viewed from the earth's surface. The relation of sunlight to skylight was important, and was measured. At the earth's surface on clear days the sky contributes about 20 per cent of the total light. At an altitude of 20,000 feet this was found to be as low as 4 per cent. Cloudy days were also taken into consideration, and a number of diagrams were made to show all the possibilities.

An obvious ideal, from the viewpoint of low visibility, would be an airplane of complete transparency, so that the background could be viewed through the transparent medium, unaltered in color and brightness. After making an extensive investigation of these aspects and of many others, including the translucency of airplane cloth, it was decided that bleached cloth tinted slightly bluish, and maintained as translucent as possible by means of colorless "dope," was the best solution.

Visibility of Airplanes at Night

If the moon provides predominant illumination, the solution is the same as that for day-flying; however, it appears that the enemy searchlight is to be reckoned with chiefly. By painting craft a dull black or by painting only one pair of wings black, it became evident that the black craft was of lower visibility in the beam than the unblackened craft and that it was invisible in the outskirts when the other craft was plainly visible.

Marine Problems

The foregoing data were immediately applicable to sea-planes, to mines, and to submarines. The reflection-factors and colors of various kinds of water made it possible to progress rapidly with these problems. The hue of water varies from yellow-green or green for shallow water (where it partakes partially of the color of the bottom) to blue-green and greenish blue for deep, clear water.

With the advent of submarine warfare, the importance of low visibility of vessels decreased, and the principle of confusability was adopted. Many data were available on optical illusions and, briefly, illusion was the underlying principle of the grotesque patterns finally adopted. As a secondary feature, it was desirable to have the patterns merge at a distance into the desired blue-gray. The optical illusions of contrasty patterns in black and white aimed to confuse the enemy as to the course, speed and direction of his intended victim. Advisory assistance was given during the development of laboratory investigations of this phase of camouflage.

The Navy also desired a pure blue glass for making enclosing glassware for the lighting circuits of vessels. The result was a blue light of low intensity, which would have a maximum illuminating value and minimum penetrating power as compared with other colors. This glass was produced, and the Ivanhoe-Regent Works supplied many thousand pieces.

Terrestrial Camouflage

The variety of problems was infinite, so in the strenuous days when camouflage units were being formed under the Chief of Engineers, it appeared best to teach the principles of light, color, lighting and vision to the members of these units. Much time was devoted to this activity. Experiments were suggested, performed and criticized and many details were worked out in the field and in the laboratory. For example, a paint was developed which matched the green of vegetation fairly well spectrally. This feature was emphasized because it was not sufficient that colors appear the same to the naked eye. By means of colored filters before the eye or camera, differences undetectable by the unaided eye were easily revealed. Many filters were made and supplied for such experimental work, with the aim that in this manner the enemy's camouflage might be detected. Furthermore, under some conditions a color-filter will increase visibility.

In the early work with the camouflage units the available data were rare, but after the completion of the extensive measurements involved in the investigation of the visibility of airplanes, a vast amount of data was available for various phases of camouflage. As a consequence, new work was begun upon the texture, brightness and color of netting for concealment purposes, and some of the standardized patterns for cannons, wagons, etc., were shown to be futile. The problem of rendering observation balloons of low visibility was given attention among other phases. In other words, it was possible by this time to place all camouflage work upon a scientific basis of known facts.

The work on the visibility of airplanes was done for the Bureau of Aircraft Production and was submitted to Lieut.-Col. Millikan, who comments as follows upon this and other work done for the National Research Council:

NATIONAL RESEARCH COUNCIL
Acting as the
Department of Science and Research
of the
COUNCIL OF NATIONAL DEFENSE

March 26, 1919.

Mr. M. Luckiesh,
Nela Research Laboratory,
Nela Park, Cleveland, Ohio.

Dear Mr. Luckiesh:

. . . .

Since my own term as Chairman of the Physical Science Division of the National Research Council is about to expire, let me express my very hearty appreciation of the exceedingly important work which you did for the Council. From a scientific point of view we have no other memoir which is more complete or more carefully prepared than the one which you wrote on the Visibility of Airplanes.

Very cordially yours,
(Signed)
(Lieut.-Col.) R. A. MILLIKAN,
Vice-Chairman

NAVY DEPARTMENT
OFFICE OF NAVAL OPERATIONS
WASHINGTON

Nov. 2, 1918.

M. Luckiesh, Esq.
Council of National Defense,
Nela Park, Cleveland, Ohio.

Dear Sir:

We are in receipt of your letter of October 22, 1918, with attached digest of your report of the Visibility of Airplanes. This is of great interest to the Department and will enable us to proceed at once with further development in this direction.

We wish to thank you for the data which you have already furnished this office, and hope that the results of your further studies on this subject will be received.

Sincerely yours,
(Signed) G. W. STEELE,
Captain, U. S. N.

WAR DEPARTMENT
OFFICE OF THE CHIEF OF ENGINEERS
WASHINGTON

Feb. 6, 1918.

Mr. M. Luckiesh,
Nela Research Laboratory,
Nela Park, Cleveland, Ohio.

Dear Sir:

. . . .

I wish to express my great appreciation for the service that you have rendered the Camouflage Department in the past.

. . . .

Very respectfully,
W. M. BLACK
Major General, Chief of Engineers.
By Randolph F. Beardsley,
Capt., Engineer Reserve Corps.

OTHER CONTRIBUTIONS OF THE RESEARCH LABORATORY

Various other problems were investigated upon suggestions received from the National Research Council. Among these may be mentioned the design of a lamp to be used in photographing bomb trajectories, made by Dr. Worthing.

Dr. Weniger undertook an investigation of the possible use of infra-red radiation for both signalling and photographing, but this work had not led to any practical results when the war terminated.

Mr. Luckiesh also worked on the standardization and measurement of colors of flares and rockets, the range of colored lights, color-filters for various purposes, mechanical devices for attaching color-filters to binoculars, lectures to engineers on lighting, obtaining aerial data for the photographic division, and various other activities.

In addition to these specific investigations, all the members of the Laboratory staff were called upon from time to time to assist others in connection with war problems. It may be stated that practically the entire time of the Laboratory staff was given over to the study of war problems from a few months after war was declared until after the armistice was signed.

The members of the staff of the Nela Research Laboratory who entered the service are P. W. Cobb, H. M. Johnson, Lucien D. Coman, Geo. E. Hathaway and Ralph Curth. Further reference to their records may be found in Part I of this book. The men who were engaged in civilian war activities of a scientific nature are as follows:

Edward P. Hyde, Member Advisory Committee, Engineering Division, National Research Council, representing Illuminating Engineering Society.

P. W. Cobb, H. M. Johnson, W. Weniger, E. P. Hyde, Chairman, Committee on Binocular vs. Monocular Field-glasses (Sub-committee of Physics Committee, National Research Council).

M. Luckiesh, Chairman of Committee on Camouflage (Sub-committee of Physics Committee, National Research Council).

W. E. Forsythe, Member of Committee on Pyrometry (Sub-committee of Engineering Division, National Research Council).

The Nela Avenue Approach to Nela Park, showing the Gate Lodge and the Engineering Laboratory

THE WAR WORK OF THE ENGINEERING DEPARTMENT

Immediately upon the entrance of the United States into the war, steps were taken to assure the Government that all the facilities of the Engineering Department were at its disposal. As was to be expected, a great deal of work was done along strictly illuminating engineering lines, but work of a larger and more varied scope, undertaken by individual members of the Department, was greatly facilitated by the co-operation of the existing department units which were particularly well equipped to render detailed assistance. In this class may be mentioned experimental work on ground telegraph systems, development of standardized vacuum tube tests, preparation of manuscripts on protective lighting and fuel conservation, and so forth.

The Engineering Department during the war comprised the following seven Sections:

1. Executive Office;
2. Commercial Engineering Section;
3. Economics Section;
4. Illuminating Engineering Section;
5. Technical Publicity Section;
6. Research Section;
7. Testing Section.

Some of the war problems were of such a nature that they could be handled best as Section activities, because they lay within the scope of the regular Section work. Others were placed under the supervision of a certain Section to gain the advantage of centralized control but were solved by the combined efforts of several Sections working in closest co-operation. Still other problems required the attention of individuals who supplemented their own special training and experience with that of their colleagues in the Department.

During the war, a large part of the work was carried on with the greatest secrecy. Only a general indication of the work actually accomplished is permissible even at the time of this writing.

The following is a list of the war service work of the various Sections, undertaken as regular Section activities in order to gain the advantage of co-operation and organization.

THE OFFICE OF THE CHIEF ENGINEER

By reason of its function in the organization, the office of Mr. S. E. Doane, Chief Engineer, was the logical point of departure for supervisory control over the various activities. In this connection an informal committee consisting of representatives of the Engineering Department, Lamp Development Laboratory, and Nela Research Laboratory, was organized in the spring of 1918. The following general projects were taken under consideration:

(1) Complying with requests from different branches of the Government for special lamps and lighting equipment;
(2) Arranging conferences with men from the Lynn Works in connection with the searchlights and signal-lights which that Works was developing;
(3) Arranging means for co-operation with the other principal lamp manufacturers;
(4) Arranging for the early and successful termination of the various activities after the cessation of hostilities.

This committee held a number of meetings, two of which were attended by Major Mendenhall of the Signal Corps, Science and Research Section, and one of which was attended by Lieut. Tate of the same Section.

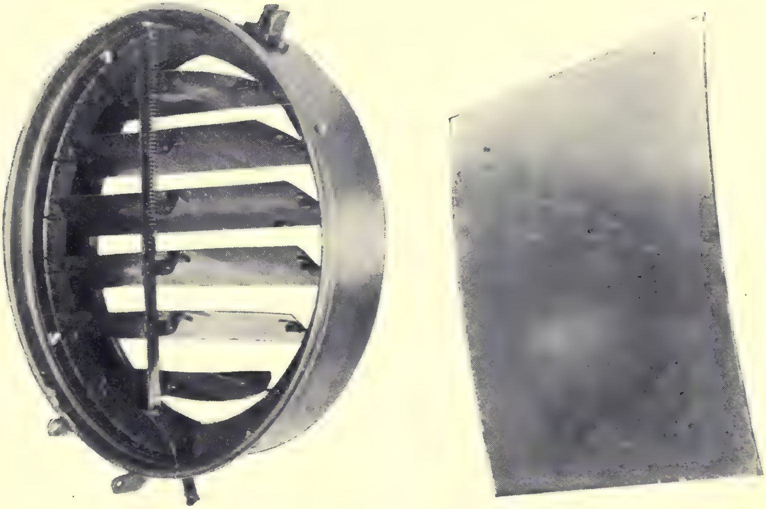
THE EXECUTIVE OFFICE

With a desire to serve to the fullest extent in the prosecution of the war, Mr. W. M. Skiff, Manager of the Engineering Department, and his staff, in conjunction with the Office of the Chief Engineer, laid before the government departments the services of the personnel, organization and equipment of the Engineering Department and conferred with numerous officials as to what problems could most effectively be handled by the Engineering Department. In addition to tendering the services of the Department to the Government, this Section took up the following work

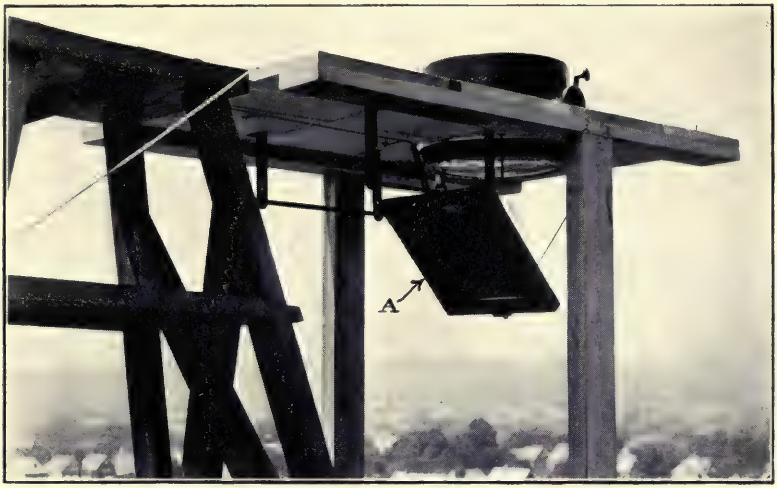
(1) Assisting in the work on pliotron tubes, signal apparatus, searchlights, and ground telephone systems;
(2) Switchboard layout and control apparatus for U. S. dental trucks.

The design and construction of special machinery and the standardization of tests helped to make quantity production of vacuum tubes possible. These tubes played a

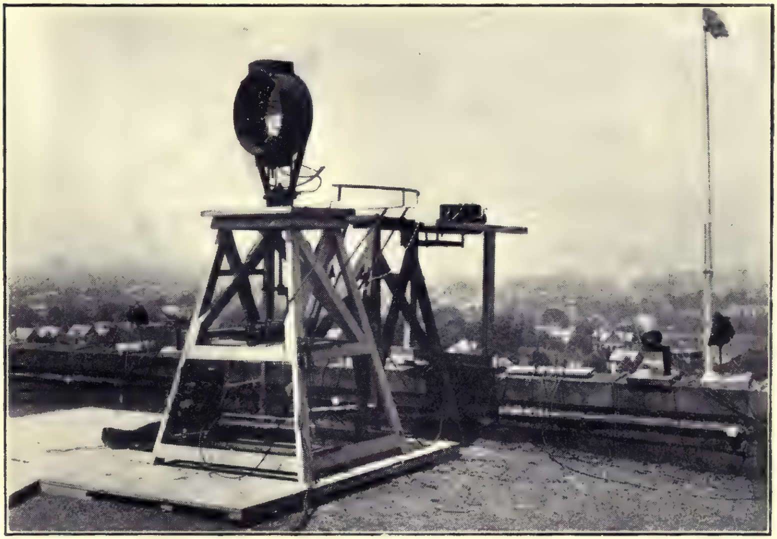
Samples of 33-ampere and 80-ampere 12-volt Projector Lamp developed for use in Combined Landing-and-Searchlight Unit for Airplanes



Shutter Arrangement and Convex Mirror, used in the Landing-and-Searchlight Unit



When used as a Landing Light on an Airplane, the Convex-Mirror A was lowered as shown and the beam directed to any spot on the Landing Field



General View of Complete Set-up for the Various Tests on Landing and Signalling Lights highly important part in the development of successful radio communication (see pages 229 to 246).

Commercial Engineering Section

The contributions of this Section to the war work of the Government were grouped under two headings; that taken up at the request of the War Department for the Army and that taken up at the request of the Navy Department for the Navy.

At the request of Mr. P. F. Bauder, Manager of the Miniature Lamp Department of the National Lamp Works, a committee consisting of Messrs. J. T. Caldwell, C. M. Bunnell and W. McKay were appointed to handle all miniature lamp activities for the National Lamp Works, the Edison Lamp Works, and the H. W. McCandless Company respectively. Complete co-operation existed in all this work and, as a result of the joint committee, results were obtained most efficiently.

Further co-operation was obtained from the Burgess Battery Company, Madison, Wisconsin; the National Carbon Company, Cleveland; and the American Eveready Works of the National Carbon Company, by the submitting of sample batteries free of charge for test purposes. Likewise, Mr. Nightingale of the Willard Storage Battery Company, Cleveland, was of great assistance in supplying sample storage batteries for test purposes for all developmental work where storage batteries were used. Close co-operation was maintained with Mr. C. A. B. Halvorson, Jr., of the Lynn Works of General Electric Co., on all work pertaining to searchlight lamps.

Some of the developments and co-operative work which were carried on for the Government are as follows:

1. Landing-Lights for Airplanes.

(a) Development of landing-lights, searchlights, navigation, compass and instrument lights for four types of electrically equipped planes, for the Production Engineering Department, Bureau of Aircraft Production.

(b) Compass lamp for non-electrically equipped plane, Production Engineering Department, Bureau of Aircraft Production. A 1½-volt, 0.35-ampere, G-3½ lamp was recommended.

(c) Sample 8-inch and 12-inch metallic reflectors designed by the Section and manufactured by the Guide Motor Lamp Company were developed but, due to various difficulties from the use of metallic reflectors, it was decided to concentrate on the use of the 11-inch diameter, Navy searchlight, parobolic-glass mirror for a combined landing and searchlight unit. This unit was developed for the Section by the Lynn Works of the G. E. Co., and tested out in July, 1918. The preliminary tests proved satisfactory to the Bureau of Aircraft Production representatives.

(d) Sample 12-volt, 12 ampere, G-25 MAZDA C lamp developed for G. E. (Lynn) 5-inch landing light.

(e) Sample 33-ampere, 12-volt, G-30; 50-ampere, 12-volt, G-30; and 80-ampere, 12-volt, G-40 MAZDA C projector lamps developed for the Production Engineering Department, Bureau of Aircraft Production, for 11-inch diameter combined landing and searchlight unit; this unit was recommended for final test for airplane service.

(f) A 15-ampere, G-25, C-5 and C-8, D. C. Bayonet MAZDA C lamp to be operated from a 5-cell Willard Storage Battery of the SBR type was developed for use as a landing-light on Caproni Bombing Plane.

(g) An inquiry was received for the development of a 12-volt airplane landing-light lamp to cover a circular spot 100 feet in diameter from a height of 500 feet, for the Aircraft Division of the Ford Motor Company. This development was held up to await final test on the combined landing and searchlight unit.

(h) A 12-16-volt, 1½-ampere, 24-candlepower, G-12, C-8, D.C. bayonet MAZDA C lamp with a life of 100 hours, was developed for Lt. W. H. Smith of the Bureau of Steam Engineering for use in small searchlights and landing-lights on seaplanes. The five sample lamps submitted proved satisfactory from the standpoint of illumination and vibration test, but the searchlight unit was unsatisfactory for landing on water.

2. *Airplane Signal-Lights and Searchlights.*

(a) A 240 watt, 12-volt, G-30 MAZDA C lamp developed for G. E. (Lynn) 7-inch diameter parabolic combined searchlight and signal unit.

(b) Sample 2-ampere, 6-volt MAZDA lamps developed for G. E. (Lynn) 6-inch diameter signal unit.

(c) 1¼-ampere, 4-volt, G-12 MAZDA lamp developed for G. E. (Lynn) 3½-inch diameter portable signal unit.

(d) Sample 1-ampere and 2-candlepower, 12-volt, flattened double helical filament, D. C. bayonet MAZDA C lamps were requested to be developed by Major C. E. Mendenhall in the Evans spiral mould bulb containing a segment of parabola and sphere in one bulb, in order to make each lamp an individual signal unit. This development was impractical, due to the contour of the bulb, and was not carried to completion.

(e) The rate of sending and receiving light signals from incandescent lamps, as obtained from various corps officers and instructors, was forwarded to Major C. E. Mendenhall of the Research and Science Division.

(f) Complete information on various types of lamps for signal work was forwarded to Lts. A. E. Hults and Jacobus, and Major C. E. Mendenhall, at the request of S. P. Wilbur, Production Department, Bureau of Aircraft Production.

(g) At the request of the Bureau of Steam Engineering Department, sample 100 watt, 32, 80, and 115-volt, G-16½, C-5 filament MAZDA C lamps with special base were developed to be used in the Aldis Daylight Signal units, and to be operated from regular ship circuits, thus eliminating the use of storage batteries. The above samples proved satisfactory and were approved.

(h) At the request of the Bureau of Steam Engineering, proper 32, 80 and 115-volt MAZDA lamps to replace the 2.5-volt, 0.30-ampere, F. E. 3¾ MAZDA flashlight lamp; and 6-volt, 2½-amp., C-8, G-12 MAZDA lamp for the portable tube blinker were supplied. The lamps were operated in a 3¼-inch diameter, ¾-inch focus, parabolic reflector.

(i) Proper lamps for four and eight No. 4 Reserve Dry cells for 14 and 24-centimeter French signal units for Major Evans and Major Mauborgne, Engineering Division, Signal Corps, Washington, and the Delta Electric Co., Marion, Ind., were developed and approved.

(j) A 12-volt, 2-ampere MAZDA lamp for 6-inch aeroplane signal unit for Major Mendenhall and Lieutenant Tate, Research and Science Division, Bureau of Aircraft Production, Washington, and the Lynn Works of the G. E. Co.

(k) Investigation of the beam candlepower necessary for daylight signalling for Major C. E. Mendenhall and Lieutenant Tate, Research and Science Division, Bureau of Aircraft Production, Washington, and Mr. S. P. Wilbur, Production Engineering Department, Bureau of Aircraft Production, Dayton, Ohio.

(l) Standardization of the use of the regular 2.5-volt, 0.3-ampere, FE3¾ MAZDA flashlight lamps for Navy portable blinker tubes for the Bureau of Steam Engineering; Commander Castle, T. L. Gatchel and Lieutenants Knight and Smith and the Delta Electric Co., Marion, Ind.; also the Wakefield Brass Co., Vermilion, Ohio.

(m) Replacing the present blinker tube lamps with regular 32, 80 and 125-volt MAZDA lamps and thus standardizing on lamps of regular ship voltages for the Bureau of Steam Engineering.

(n) Revision of "Aldis" daylight signal lamp, English specifications, for Bureau of Steam Engineering.

(o) Sample 6-volt, 0.60-ampere, G-10 clear, and G-10 ruby, D. C. medium bayonet MAZDA C lamps for use on 4 No. 6 reserve cells; and 12-volt, 0.60-ampere, G-12 clear and G-12 ruby, D. C. medium bayonet MAZDA C lamps for use on 8 No. 6 reserve cells. These lamps were used as signal lamps in the 14 and 24-cm. French projectors developed by the Delta Electric Company.

200,000 lamps were supplied to the Delta Electric Company.

(p) Information on MAZDA C Projector lamps when used on Delco Country Home Lighting outfits, was supplied to Mr. W. H. Booker of the North Carolina State Board of Health for educational work in France.

(q) A 3-ampere, 10-volt, G-16½ D. C. bayonet C-2 filament MAZDA C lamp, with a life of 10 hours on a battery of the 5-cell Exide AC-7 and Willard SY-89, was developed for the Bureau of Steam Engineering, Navy Department, to be used in the portable searchlight with an 8½-inch diameter, 1⅜-inch focus, parabolic reflector. This lamp proved satisfactory.

3. *Indicator Lights*

(a) Sample 6-volt, 0.15-ampere, G-3½ MAZDA lamps with two No. 1822 bases; and 6 and 12-volt, 0.15-ampere, T-3 MAZDA lamps with two No. 1822 short bases were developed for the Metal Specialties Company of Chicago for meter lamps on the De Haviland planes, manufactured by the Dayton-Wright Aeroplane Company. These lamps fitted into a sleeve with a graduated slot to permit whatever intensity of illumination was desired on the various instruments, depending upon the period of the day in which the lamps were operated. These lamps, while satisfactory, were not approved, due to the non-approval of the apparatus.

(b) A 12-volt, 0.12-ampere, 0.10-candlepower MAZDA G-6 clear, C-6 filament, D. C. bayonet MAZDA lamp was developed and approved as the DH-I lamp; this lamp was used as the instrument lamp on the De Haviland-4 plane.

(c) A 12-16 volt, 0.42-ampere, 4-candlepower, G-8 clear, C-2 filament, D. C. bayonet MAZDA lamp was recommended and approved as the DH-N lamp; this lamp was used as the navigation and tail-light for the De Haviland-4 plane.

(d) A 12-volt, 0.12-ampere, 0.10-candlepower, G-3½ frosted miniature screw, C-2 MAZDA lamp was developed as the DH-C lamp; this lamp was used as the compass lamp on the type B Sperry compass used on the De Haviland-4 plane. Various orders for the three items above were supplied to the Metal Specialties Company, Lynn Works of General Electric Company and to many other customers.

(e) The 6-8 volt, 1½-ampere, 10-candlepower, G-12 clear, D. C. bayonet, S-4 filament MAZDA lamp was developed and approved as the navigation lamp for the JN-6 H. B. plane.

(f) A 2-ampere, G-12 D. C. bayonet, C-2 filament MAZDA lamp to be operated from a 5-cell Willard Storage battery of the SBR type was developed for the Bureau of Aircraft Production for use on the Caproni bombing plane.

(g) A 12-volt, 1½-candlepower, G-3½, C-2 filament, miniature screw base MAZDA lamp was developed as a special airplane instrument lamp for Major C. E. Mendenhall of the Research and Science Division; the lamps were approved but could not be used, as the instruments in which they were to be mounted could not be obtained from the English Government.

(h) A 12-16 volt, 0.26-ampere, 2-candlepower, G-6 S. C. bayonet MAZDA lamp was developed for Major Mendenhall and the W. C. Rieker Company, Philadelphia, Pa., for use in the Airplane Inclinometer.

(i) A 3½-ampere, 14-volt, 60-candlepower, G-16½, C-6 filament, D. C. bayonet MAZDA C lamp was developed for the Western Electric Company, N. Y.; 230 sample lamps were shipped to Messrs. Ranney and Jewett of the Western Electric Company and proved satisfactory.

(j) A 9-volt, 0.26-ampere, 2-candlepower, G-6 S. C. bayonet MAZDA lamp was recommended to the Production Engineering Department, Bureau of Aircraft Production, as a trouble-lamp on airplanes. This lamp was approved.

(k) Mr. G. S. Merrill submitted sample 110-volt, 2-candlepower, G-8 D. C. bayonet Carbon lamp to Capt. G. F. Gray of the Radio Section, Signal Corps, as an indicator lamp.

(l) Requests came from the Indiana Lamp Company, Julius Andrae and Sons, and the Corcoran Victor Co., Cincinnati, for 150-watt and 250-watt, 12-volt, G-30 bulb, D. C. medium bayonet MAZDA C lamps, for 7-inch diameter parabolic reflector searchlights and 72-watt, 12-volt, G-25 D. C. medium bayonet MAZDA lamp in a 5-inch diameter parabolic reflector landing-light; and 3-candlepower, 12-volt, G bulb bayonet base, marker and tail lights for seaplane. Samples were submitted.

(m) A 12-volt navigation lamp for use on a Navy seaplane was requested by the Bureau of Steam Engineering; the lamp submitted and which proved satisfactory was a 12-volt, 0.26-ampere, G-6, D. C. bayonet, 3-candlepower, MAZDA automobile lamp.

(n) At the request of the Goodyear Tire and Rubber Company, Akron, Ohio, through Mr. R. H. Upson, Aero Engineer, a 6.2-volt, 0.30-ampere, G-5½ MAZDA lamp operated from a No.710 Eveready Flashlight battery, was supplied as a dirigible pilot light; the weight of the complete outfit was not to exceed one pound, nor was the buoy to extend to a greater depth than 18 inches in the water; the life of the lamp was to be from 15 to 20 minutes.

4. Trench Signal and Special Lights.

(a) A 2-ampere, 6-volt, G-12 D. C. bayonet S-4 filament MAZDA C lamp was developed for the trench signal unit for Major Mendenhall by the Lamp Development Laboratory and Dr. Worthing; lamps were supplied through the Lynn Works of the G. E. Co., for 300 units.

(b) A 6-volt, 2-ampere MAZDA lamp for 6-inch trench signal unit for Major Mendenhall and Lieutenant Tate, Research and Science Division, Bureau of Aircraft Production and the Lynn Works of the G. E. Co., was submitted and approved.

(c) Trench sight, including lamp, for use on six different types of mounts for Captain D. S. Cole, Engineering Division, Mobile Gun Carriage Section, Ordnance Department, Washington.

(d) A ½-ampere and a 1-ampere, G-8 MAZDA lamp for use on the Exide AC-7 and Willard 2-cell battery to meet Navy specification of 10 hours' life on the battery, were developed for the Hawthorne Manufacturing Company and Grether Fire Equipment Company; four hundred lamps were shipped to the Grether Fire Equipment Company after samples had proven satisfactory. Samples were also sent to the Bureau of Steam Engineering.

(e) Duplicate samples of the English lamps used in the Aldis Daylight Signal Unit were submitted to the Bureau of Steam Engineering together with samples of similar lamps with the modifications for test purposes that at 10 volts the lamps were to rate 50-candlepower at 0.70 w. p. c. and at 12 volts, 100-candlepower at 0.45 w. p. c., using a C-2 filament G-16½ bulb special base. Both samples were approved by the Bureau of Steam Engineering, and were to be used with the Willard SY-67 or SOR-26 type storage battery; an order for 36,000 lamps was placed after the test on the above sample.

(f) The U. S. Naval Experimental Station at New London, Connecticut, requested the development of a 200-watt, 30-volt, T-14, C-5 or C-13 filament, MAZDA C lamp and 600-watt, 30-volt, T-20, C-14 filament with a source size not exceeding one inch square, either in the shape of a circle or triangle in a horizontal plane.

(g) A 4.0-volt, 0.50-ampere, G-5, S-3 filament special base MAZDA lamp of 300 hours' life, was developed.

5. *Hand-Lantern, Tractor and Army Truck Lights.*

(a) 2-volt, 0.30-ampere, 0.50-ampere, and 0.80-ampere, G-5½ miniature screw MAZDA lamps for hand-lanterns were recommended to the O. M. O. Storage Battery Company. One hundred samples of each lamp were submitted.

(b) A 2.5-volt, 0.30-ampere, F. E. 3¾ opal back flashlight lamp was recommended to the Ordnance Department through the Delta Electric Company for hand-lanterns; approximately 100,000 lamps were originally supplied.

(c) Request for the development of 1-ampere, 2.5-volt, G-10 D. C. bayonet MAZDA hand-lantern lamps to be operated from 2 No. 6 dry cells in series, using dark blue glass bulbs to decrease the visibility of the lamp on board of ship. A regular 1-ampere, 2½-volt, G-10 MAZDA lamp, clear bulb, was recommended for the above service, using a special Ivanhoe-Regent blue cover glass for the cover plate in the hand-lantern. This was approved by Mr. T. L. Gatchell, Bureau of Steam Engineering, Navy Department.

(d) The development of a 2.5-volt, 1.0-ampere, G-10 bulb, D. C. bayonet, S-2 half-twist filament, to be operated from 2 No. 6 dry cells in series, and to give a life of ten hours on the battery, was developed for the Bureau of Steam Engineering, Navy Department, for use in a $5\frac{1}{16}$-inch diameter, 1-inch focus reflector for Navy hand-lanterns. This lamp was approved.

(e) A 1.0-ampere, 4.0-volt, G-8 D. C. bayonet, S-2 filament MAZDA lamp to give 10 hours' service on 2 cells of the Exide AC-7 and Willard SY-89 type battery was developed for the Navy hand-lantern for the Bureau of Steam Engineering; samples were submitted to the Navy Department, Grether Fire Equipment and Hawthorne Manufacturing Company, and were approved.

(f) 18-24-volt, 21-candlepower, G-12 MAZDA headlight lamps and 18-24-volt, 4-candlepower, G-8 MAZDA lamps, for use on the Fordson Tractor, were recommended to the Edison Lamp Works and to the Peerless Lamp Division of the National Lamp Works.

(g) The following lamp specifications were supplied to Capt. William M. Britton and Major Edward Orton, Transportation Division, Q. M. Corps and to the Lynn Works of G. E. Company, for MAZDA lamps to be used on army trucks: the projector lamp, 6-volt, 6-ampere, 60-candlepower, C-8, G-18½, SC bayonet, MAZDA C lamp for searchlight; 2½-ampere, 6–8-volt, 21-candlepower, G-12, MAZDA C lamp for special searchlights; instrument lamp 0.84-ampere, 3–4-volt, 2-candlepower, G-6 MAZDA; special lamps 1.25-ampere, 6–8-volt, 6-candlepower, G-8, and 1.50-ampere, 6–8-volt, 12-candlepower, G-8. These lamps were used in the specifications for 40,000 1½-ton and 3-ton gas motor trucks equipped with lead-acid type storage batteries.

6. *Gun Sights for Ordnance Department.*

(a) A 1.25-volt, 0.12-ampere, T-1½ frosted, minimum candlepower, special miniature base, MAZDA lamp and bead-sight was developed as an illuminated bead-sight for Major A. G. Newton and Capt. P. R. Forman of the Production Engineering Department, Bureau of Aircraft Production, on the Lewis Machine Gun on airplanes. The bead-sight contained a fountain-pen type flashlight battery to operate the lamp, and likewise a switch for turning the lamp on and off. The use of the flashlight battery was to eliminate the necessity of wiring for a lamp on the machine-gun; the bead-sight was used both with and without the rear sight on the gun by interchanging the shank on the unit. 250 samples were manufactured by Mr. J. T. Fagan, Manager of the Equipment Development Department, and submitted to Major Newton. The lamps and apparatus proved satisfactory, but the battery would not stand up. Messrs. Forsythe, Dows and Caldwell developed the original sample which was approved.

(b) A lamp for the illuminated wind-vane sight on the Lewis machine-gun, of the same candlepower rating as the illuminated bead-sight lamp, was being developed for Capt. P. R. Forman, Ordnance Department, Production Engineering Department, Bureau of Aircraft Production, but was cancelled by the signing of the armistice.

(c) A 3-volt, 0.30-ampere, 0.8 to 1.0-candlepower, G-6, D. C. bayonet MAZDA lamp with a wire and bead mount was developed and approved for the Mobile Gun Carriage Section, Ordnance Dept., to be used in the night firing-boxes and Mobile Gun Carriage lamps for six types of guns. 1500 lamps were ordered for final test. At the time the armistice was signed an order for 483,600 lamps was hinging on the above approval. Capt. W. M. Wiley of the Mobile Gun Carriage Section approved the use of the above lamps for both purposes, thus eliminating carrying two types of lamps in stock.

(d) A 1½-volt, 0.60-ampere, G-5½ miniature screw MAZDA flashlight lamp operated from a No. 6 reserve cell and using an optical system with a pattern of the gun sight on the lens, was developed as an illuminated trench sight, for Capt. D. S. Cole of the Ordnance Department. This was to be used on six types of guns.

(e) Recommendations for etching the reticule of the unit sight were forwarded to Major Mendenhall, and he was referred to Capt. D. S. Cole for further information; the recommendations forwarded were originally obtained from the Kollmorgen Optical Company.

(f) A 6 to 8-volt, 0.42-ampere, 2-candlepower, G-6, S-3 filament with one anchor, candelabra screw D. C. bayonet base MAZDA lamp was recommended to the Carroll Electric Company, Washington, as a gun-sight lamp on a 3-inch gun carriage and was operated from a 6-volt storage battery.

(g) A 3-volt, 0.3-ampere lamp to be operated from two No. 6 dry cells for the Mobile Gun Carriage mounts for the Ordnance Department; Captains Hill and W. M. Wiley, Washington, and the Stewart-Warner Co., was submitted and approved.

Well over 500,000 lamps were supplied to the Army and Navy Department as a result of the above work.

ILLUMINATING ENGINEERING SECTION

The principal subjects on which aid was given to the Government by this Section are as follows:

(*1*) *Lighting Curtailment.*—Assisting in the preparation of a report for the Fuel Administration which formed the basis of their propaganda for the conservation of fuel through lighting economies.

(*2*) *Protective Lighting.*—The Military Intelligence placed on this Section the responsibility of working out and disseminating methods and means for producing efficient flood-lighting. In this connection papers and discussions were given before meetings of engineers, safety men, and plant managers; articles were published in technical journals; specific recommendations were made for individual jobs in government plants.

Furthermore, members of the Section co-operated with projector manufacturers in getting out a properly designed projector flood-lighting service, which was much more efficient than any previously available.

(*3*) *Steel Conservation.*—A sub-committee drew up a report which was presented to the War Industries Board, on the conservation of metal in reflectors for industrial and government use. It included a standard list of reflectors for specification by government departments, which was accepted. The report called particular attention to the undesirable effect which a ban on reflector manufacture would have in increasing the necessary consumption of coal for electric lighting.

(*4*) *Camouflage.*—A problem referred to this Section by the Naval Consulting Board had to do with marine camouflage by illumination,—that is, rendering the upper parts of a vessel invisible even in silhouette against a clear sky by illuminating all surfaces to a brightness and color exactly equal to that of the sky behind it.

Attempts to solve this problem revealed many unanticipated difficulties, and experiments extending over a period of more than a year were necessary at Cleveland and at the Submarine Base at New London, Conn. In the course of the work an instrument was developed which, when used on the deck of a vessel itself, was capable of indicating an equality of brightness between the parts of the vessel and the sky behind it, as it would be viewed by enemy observers located at all points on the horizon.

In addition to that portion of the work rendered through the Illuminating Engineering Society Committee, assistance was given directly to the Engineer Corps in the lighting of buildings, to the Ordnance Corps in the illumination of proving grounds, and to Navy Yard officials in the lighting of shops.

RECOMMENDATIONS MADE BY SUB-COMMITTEE ON LIGHTING FOR NIGHT FLYING

An investigation of the lighting requirements for night flying was made through visits to typical U. S. aviation camps, interviews with American and French flying officers and civilian aviators, and by means of a study of the published matter on the subject. For meeting these requirements, suggestions were offered which in the judgment of the committee primarily insured safety and convenience both for night ascent and landing. They were made also with regard for the cost of installation and operation and availability of material. The plan was made flexible in order to provide for individual machines, groups or squadrons. A diagram of a complete lighting system for a single unit of a typical camp is shown in the accompanying illustration, but it may be adapted to larger or smaller portions of a given aviation field. The suggestions were selected from a number of practicable methods and were not submitted with the thought

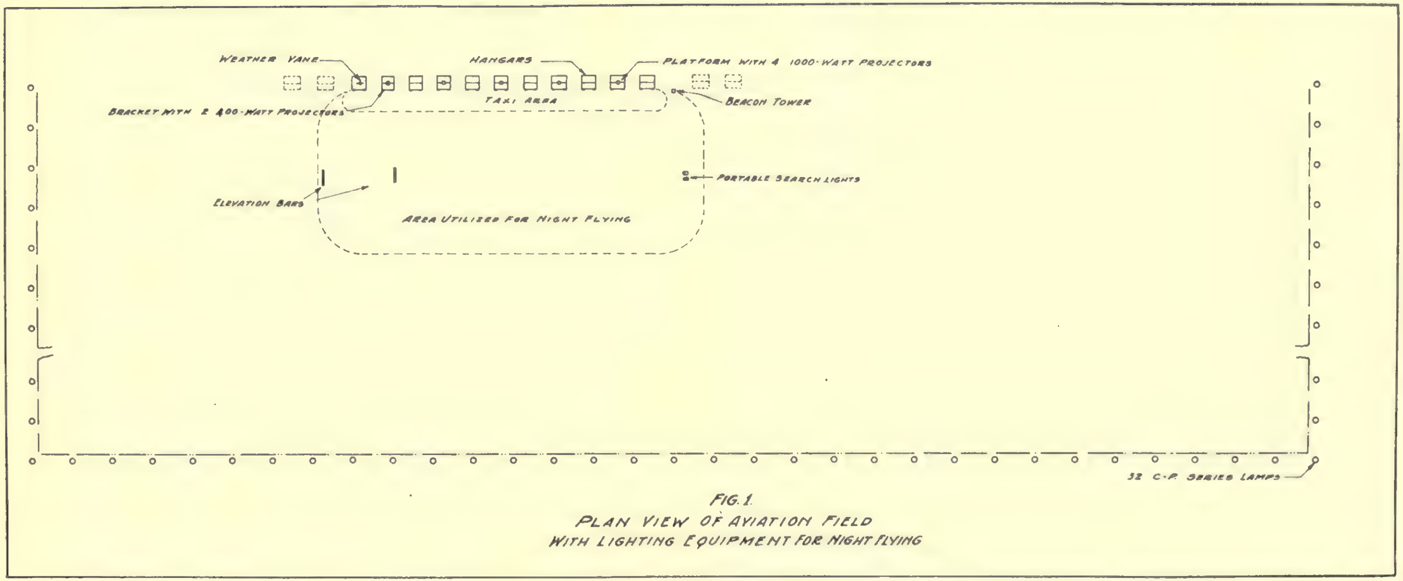

WEATHER VANE
HANGARS
PLATFORM WITH 4 1000-WATT PROJECTORS
BRACKET WITH 2 400-WATT PROJECTORS
TAXI AREA
BEACON TOWER
PORTABLE SEARCH LIGHTS
ELEVATION BARS
AREA UTILIZED FOR NIGHT FLYING
32 C.P. SERIES LAMPS

FIG. 1
PLAN VIEW OF AVIATION FIELD
WITH LIGHTING EQUIPMENT FOR NIGHT FLYING

Plan View of Aviation Field, with Lighting Equipment for Night Flying, as Recommended by Illuminating Engineering Section, Engineering Department, Nela Park that they were necessarily complete solutions. By actual trial installations and observations from the air, the details of the several proposals could be so modified as to secure the maximum effectiveness.

The requirements for a lighting system for night flying are as follows:

(*1*) Beacon or orientation lighting;
(*2*) Identification markings for a given field;
(*3*) Definition of field limits;
(*4*) Ocular signalling system between field and plane;
(*5*) Indication of wind direction;
(*6*) Accurate indication of landing level;
(*7*) General illumination of a portion of the field;
(*8*) Higher illumination of taxi strip;
(*9*) Emergency lighting.

For beacon or orientation lighting, it was recommended that a device be provided embodying a total of 36 small projectors, mounted on a 180° arc of 6-ft. radius. Each projector consisted of a parabolic reflector, preferably of mirrored glass and about 6 inches in diameter, with a 12-volt, 24-candle-power MAZDA C headlight lamp in G-12 bulb; the resulting spread of beam was not less than 5°. The device was mounted on a vertical shaft which was connected with a motor for rotation at desired speed. The 18 lamps on one quadrant were connected through a transformer to the regular 110-volt supply, the others being available for substitution. A 12-volt battery was provided for emergency connection. When the device was rotated with the lamps on one quadrant burning, a flash from some projector was received at every point in the upper hemisphere once for each revolution, except that within a cone of 5° from vertically above the device the indication was a steady beam. The energy required for the lamps was less than 250 watts. The beacon was mounted on a platform about 50 feet above the ground. Under ordinary atmospheric conditions the beacon was visible at a radius of at least 25 miles.

As an auxiliary for use under unfavorable atmospheric conditions, a 24-inch high efficiency arc searchlight, mounted on the same tower, was employed, either turned upward or with a portion of the beam so directed by means of a mirror attachment.

Identification of a field could be accomplished by characteristic flashing of a beacon adapted for that purpose, By utilizing both quadrants with light of the same or different colors, by means of multiples of this device, or by different speeds of rotation, a considerable range of characteristic flashes was made possible. The searchlight beams could likewise be made characteristic through motion or occulting.

Where camps are numerous, it was advisable to provide numbers or other characters as identifying marks on the field itself. Such luminous characters, covered by glass in frames flush with the ground and made 25 feet in length, would require from 2 to 2.5 kilowatts each and could be read at a distance of two or three miles.

It was recommended that the field limits be defined by 32-candlepower series MAZDA C lamps, equipped with 10-inch diffusing globes with 4-inch filters and mounted pendant on brackets approximately 330 feet apart. A mounting height of 15 feet was suggested, but this could be varied; a uniform height from the field was, however, desirable. The plans for the lighting of the camp originally included a 100-watt lamp in a diffusing globe mounted on a bracket 15 feet above the ground at either end of each hangar on the field side, these lamps completing the outlining of the field limits.

Since it was necessary for the signalling system to conform to the general practice of the Service, it is not discussed here. However, the possibility of applying a device such as the beacon is immediately obvious.

In order that aviators might know the direction of the wind, for landing purposes, it was recommended that a ten-foot weather vane carrying a row of red lamps with the arrow head also outlined in red, be mounted on one of the hangars, as indicated in the cut on page 290.

If a larger and more easily observed method was desired, and an identifying marking was used out in the field, red lights flush with the ground could be provided at eight points of the compass and at a radius of several hundred feet from the central marker. Each of these red lights was connected through a relay and commutator segment to a weather vane, which automatically kept one or two of the red signals lighted and thus, with the white center mark, indicated the direction for landing.

In order to enable the aviator to know when he was approaching and when he had reached a definite level above the landing field, it was recommended that two portable

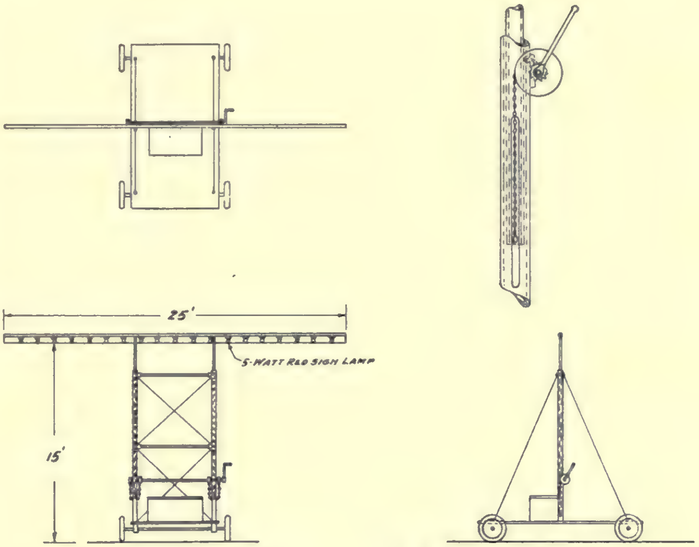


FIG. 2.
ELEVATION BARS FOR NIGHT LANDING

25-foot bars be mounted horizontally 15 feet above the ground, as indicated by Fig. 2. Each bar was equipped with twenty-five 5-watt, 10-volt red sign lamps shielded so that they were visible from only the one side. The truck carried a 12-volt, 150-ampere-hour battery. The bars were placed parallel on the field and perpendicular to the direction of the wind so that landings could be made toward the bars. There was a separation of about 200 yards between bars so that the error in estimating the 15-foot level by the merging of the bars was reduced to a minimum. The height of the bars was made adjustable to permit proper alignment where the field was not level. A stepladder and a 15-foot pole were also provided so that they could be placed on the landing stage and the proper height of the bars determined by sighting over the pole.

To facilitate landings when a number of planes were up, it was recommended that the entire portion of the field in which the planes or men move about be flood-lighted to a moderate intensity. Fig. 3 shows the elevated platforms which were placed about 50 feet above the ground on alternate hangars, four 1000-watt projectors being mounted on each. The prevailing winds were lengthwise of the field in either

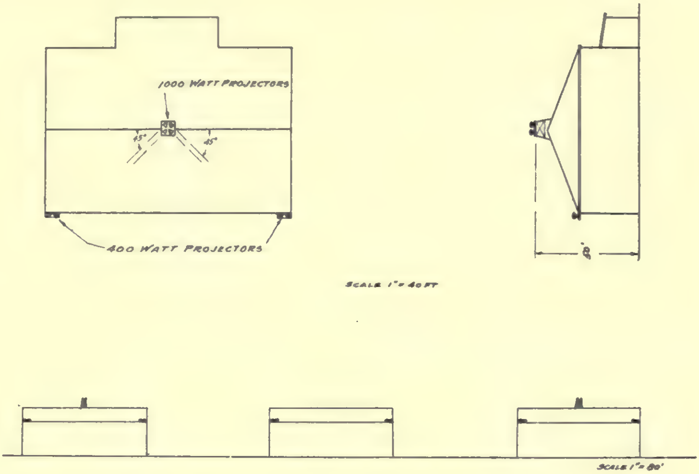


FIG. 3.
LOCATION OF PROJECTORS
FOR ILLUMINATION OF TAXI AREA AND FIELD

direction. In order to minimize glare, the projectors on each platform were divided into two groups, directed at 45° to the edge of the field. Only that half of the projectors pointing most nearly in the direction for landing was to be used at one time. The projectors had a beam spread of about 15°, such, for example, as given by the G. E. L-12 projector with a 1000-watt flood-lighting lamp.

For the illumination of a more limited area anywhere on the field or the more intense lighting of the landing stage, one or more portable incandescent searchlights, such as the Edison Storage Battery Searchlight, were provided. The 34-volt, 750-watt MAZDA C headlight lamp was employed in a parabolic reflector and connected to a battery of not less than 300 ampere-hours for each lamp. Such equipment would be most useful mounted on a Ford car, as regularly available for fire departments.

To facilitate work on the engines and planes, it was recommended that additional light be supplied to the taxi area by projectors placed in groups of two on brackets at either end of each hangar as shown in Fig. 1. Each unit was equipped with a 400-watt MAZDA C flood-lighting lamp and had a beam spread of 30° to 50°, such as is obtained with the G. E. L-3 projector. The units were directed downward at an angle of 30° from the horizontal and with the inner edge of the respective beams grazing the hangar walls in either direction.

A 24-inch high-efficiency arc searchlight could be mounted on the beacon tower and an attendant be stationed there to direct the beam to any part of the field or surroundings in the event of an emergency.

The use of a searchlight on the Ford car made it possible to have plenty of light available at any part of the field or camp in case of accident. Failure of the main electrical service would not make night landing unsafe.

TECHNICAL PUBLICITY SECTION

Throughout the war, every effort was made to discourage the use of light for non-essential purposes and to assist, through the dissemination of sound and accurate advice, in the development of the more important fields of illumination, such as industrial lighting of productive intensity, and protective lighting.

A typical example may be mentioned. When the United States entered the war, the Technical Publicity Section compiled, edited and published a 12-page bulletin on Protective Lighting for Industrial Plants in four days. The bulletin was thorough, complete and authoritative in spite of the fact that it was put out in such haste, and it was the only publication of its kind available during the first year of the war.

On the other hand, when calls came in for articles on such subjects as sign lighting, for example, not only were these articles *not* supplied, but letters were written to the people who requested this service, stating that the publication of such material was not thought to be compatible with the country's best interests.

RESEARCH SECTION

Following is an outline of the Government work accomplished:

(1) Made small comparison photometer for Ivanhoe-Regent Works, by use of which delivery was speeded up and the waste of

time and material in making up globes that would ultimately be rejected was eliminated.

(2) Obtained discharge curves on various types and brands of batteries, including Burgess Super 6, Columbia No. 6, Reserve No. 04 Aldis, several types of Willard Storage batteries and fountain pen type batteries for use with machine-gun bead-sight lamps.

(3) Rebuilt, calibrated and repaired instruments for use in government work. Quite a number of instruments were loaned to the Chemical Warfare Service, U. S. Army.

(4) Obtained transmission measurements on blue glass globes used by the Navy.

(5) Conducted characteristic tests on pliotron and kenotron tubes. Special and freak tubes, which were discovered in the regular production, were tested in this Section.

(6) Carried on experimental work in connection with the T. P. S. (ground telegraph) sets. Oscillograms showing performance, wave form, etc., of the various circuits were obtained.

The data obtained through these tests served as a ground for the standardization of equipment, which in the war emergency was essential.

TESTING AND ECONOMICS SECTIONS

The Testing Section co-operated with the Government on the following work:

(1) Designed and installed complicated equipment for testing vacuum tubes.

(2) Performed very special tests on many types of lamps for Lamp Development Laboratory and Commercial Engineering Section in connection with their war service developments.

It was in this Section that newly developed equipment was given actual operating tests to determine whether or not it should be manufactured in quantities. Much time and money was saved by learning, before large-scale production had begun, that certain products would not stand up under working conditions.

The Economics Section co-operated with the Commercial Engineering Section on signalling work and with the Testing Section on the compilation of data.

WAR WORK OF CHEMICAL LABORATORY

The work to which the Chemical Laboratory, in charge of Mr. J. G. Wild, was assigned was to investigate and report on the effect of various absorbents which might be employed for the purpose of removing carbon monoxide from the air. Carbon monoxide, though very poisonous, is not used as a toxic gas in chemical warfare on account of its low specific gravity. It is present, however, in high concentrations in the gases emitted from the funnels of ships to the extent that under certain conditions the men are unable to maintain their positions in the fighting tops. Trouble is also experienced with this gas in submarines. In this case, it occurs in the exhaust gases which at the time of submerging are often confined to the vessel. The gases from explosives, especially those which are irregular in their rate of combustion, contain large quantities of carbon monoxide.

Owing to the chemical properties of this gas, its elimination is most difficult. As was customary in dealing with undertakings of this nature, the Government distributed the work among several investigators. The principal contribution of the Chemical Laboratory to this subject was the discovery that when manganese dioxide was mixed with a catalyst, such as palladium, it would react with carbon monoxide. Prof. Arthur B. Lamb, who was in charge of this subject, stated that our work was of great assistance.

WAR WORK OF STANDARDIZING DEPARTMENT

The Standardizing Department took an active part in war work by designing special lamps and other devices for the use of the armies and navies of the United States and of the allies. Data for special gun-sight lamps, bomb tracing lamps, airplane compass and meter lamps, blinker signal lamps, hand lantern lamps, many types of searchlight and headlight lamps, pliotron and kenotron vacuum tubes, etc., were prepared and issued to the factories. The packing of lamps and of vacuum tubes was given special attention. Evacuated gas-sampling bulbs for use in the trenches, etc., were designed by this department with special reference to the rough treatment which these tubes must withstand.

Several of the Standardizing Department engineers gave their services in an informal way to assist in research and development work described in preceding pages of this Part.

PART III

WAR RELIEF AND EDUCATIONAL WORK

War Study Clubs; The Sock League; American Red Cross Centers within The National Lamp Works; The Nela Fund for French War Orphans, Widows and Soldier-Godsons

WAR STUDY CLUBS

And Other Educational Work

How National Employees Were Informed and Educated as to the Reasons Why America Was at War

How important the War Study work of the National Lamp Works promised to be, how important it actually was, will always be open to argument—like the unanswerable question, "Which one of the allies won the war?"

It depends upon the point of view.

This much can be said, however: propaganda and public opinion were as mighty in the conflict as munitions and men, and whoso aided straight thinking is to be judged on equality with those who taught straight shooting.

This war was a conflict of two mighty principles. On the one side was an aggressive conviction that certain Germanic peoples possessed superior qualities and institutions which should be imposed by ruthless force upon the world. On the other side was a conviction, dormant at first, but later equally strong, that freedom is the most precious thing in the world; a blessing to be maintained at all costs.

Many Germans honestly believed that their contemplated conquest of the world was for the world's good. At any rate, they inculcated this belief into every German infant, nurtured it through his childhood and youth, drilled him in the methods and skilled him in the tools of war when he reached young manhood, and so builded a nation of competent, war-crazed fanatics against the day of dreadful opportunity.

The rest of the civilized world, and especially America, accepted its privileges of freedom as a matter of course. We rather looked down upon our professional soldiery. Our ideals and aspirations were best expressed in terms of business. When we saw Cuba maltreated by Spain, we waded in, corrected the wrong and got out, about as some good-natured policeman would separate a pair of fighting schoolboys, treating the incident lightly as a part of the day's work. The idea that we were especially favored of God, or had any particular mission other than to jog along peaceably, raising crops and children, and running businesses and flivvers, did not at any time occur to us.

Then the storm broke, and our readers saw the truth. On the one side they saw ranged rabid, skilled and brutal fanaticism: on the other, amiable indifference. The first problem, and one of the biggest, was to arouse the free peoples to their danger, to stir them to fervid action, before the well-organized war machine of German kultur could enslave them.

Do you question the need, the value, the paramount importance of this rousing and stirring?

* * * *

It was to give impetus to this vital work that the Publicity Department at Nela was called upon.

In the first sweep of patriotism, the National organization did its part thoroughly and well. Our Service Flag is one of which we may well be proud. Our subscription to Liberty Loans, to welfare work, our self-denial and conservation and war-gardening—these speak openly and truly of an organization in which Americanism is solidly ingrained.

But as the real test approached, as conscription and casualty lists and suffering bit deeper and deeper, it was seen that at the bottom of the organization—at the bottom of the whole nation—was a sediment of indifference, of misunderstanding, even of selfishness, which must be stirred.

The public press was doing what it could, but many of our people were not great readers of the editorials in newspapers and magazines. It would take a great deal of such reading to find a clear and simple, yet complete explanation of just why America was in the war.

What was needed, our executives saw clearly, was a form of clean, honest, truthful propaganda through which the organization would be taught to think straight and to act with conviction. What was needed was a mental and spiritual awakening to the grim truth—not a hysterical spasm of blind fanaticism. Germany had her mad zealots. We wanted cool thinkers.

The first step, then, was the distribution to the Society of Nela, of which the National managers are members, of the book "Headquarters Nights," by Vernon Kellogg, a college professor of pacifist leanings who became a confirmed advocate of this war through his association with German commanders while serving on Hoover's relief commission in Belgium and northern France. Of this book Theodore Roosevelt said, "It is a convincing . . . exposition of the shocking, the unspeakably dreadful moral and intellectual perversion of character which makes Germany a menace to the whole civilized world."

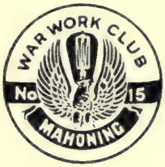
The purpose of this distribution was to insure that the leading men in the National organization should understand why "this war, once begun, must be fought to a finish," as Vernon Kellogg, the converted pacifist, declared. Let us quote the letter that accompanied the book:

> To The Members of the Society of Nela:
>
> We doubt if anyone who fully realizes the fact that we are living in the time of the greatest struggle that the world has ever seen will be willing to be in ignorance of just what is at stake. One who is without this knowledge is not in position to determine correctly what should be his part.
>
> Nor is it enough that one learn the facts for himself. He should do what he can to influence others to know.
>
> We have found this little book unusually illuminating and so we are sending it to the members of the Society of Nela.
>
> Terry and Tremaine.
>
> January 1, 1918.

The next step in the pro-freedom program was the publishing of a series of four special booklets, as follows:—

I. What is Wrong with Germany.
II. How Germany Brought About the World War.
III. Democracy *versus* Pan-Germanism.
IV. What America is Doing to Win the War.

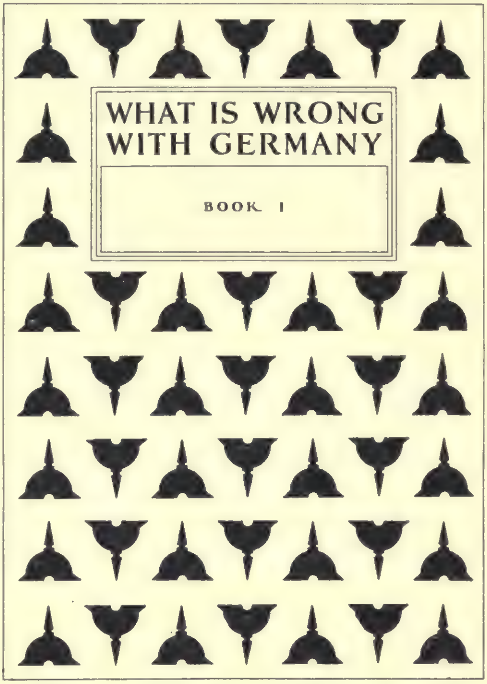
These text-books were designed as the motif for study clubs which were scheduled to be organized in every factory—clubs of not more than 20 people each, under group leaders competent to direct the thought of the employees into positive American channels, to refute the sophistry of pro-German propaganda, and to overcome indifference. The statement in the group leaders' instructions that "*winning the war is infinitely more important than making lamps*," became almost a slogan in the organization.



Among the illustrations accompanying this chapter, will be noticed a picture of one of the booklets just mentioned; also a reproduction of the button worn by members of the War Work Clubs and a photograph of one of these factory clubs studying the booklets. This particular group was at the Cleveland Miniature Lamp Division, East 45th Street, Cleveland.

Arrangements were made for having the famous film, "Wake Up, America," exhibited at each factory, with a speaker from the National Cash Register Company to make an accompanying address.

It was while this film was on the National factory "circuit" that the armistice was signed. The balance of the educational program was therefore halted. As a matter of record, and to show the thoroughness with which the work was planned, this program is appended.



WHAT IS WRONG WITH GERMANY

BOOK I

Cover Design of First Educational Booklet

* * * *

The war educational work of the National Lamp Works may be compared with that of munitions manufacturers whose shells and materials were largely in process when the war ended, or of the hundreds of thousands of troops turned back after a mere taste of the Great Adventure, by the collapse of the German war machine.

The work started when the need for it became evident: had the war lasted six months more, this work would have been of grave importance; had it lasted another year, the work would have been vital.

And the fact that this work had hardly more than got under way when its war value ceased, cannot be charged to dalliance. Located at the center of the National Lamp organization, the Cleveland General Office was in a better position than most folk to judge both the time and method of applying the melting-pot method to the organization's collective thought. The work was timed accurately to our needs, and was in force and effective at the time when as a nation we touched the apex of our contribution to the cause of freedom.

Worth while? — we go further and contend that this work is even yet worth while. The bestial philosophy known as Neo-Darwinism is still rampant in parts of Germany. It was this mad theory of "might makes right" that the Publicity Department was called upon to fight, and did fight. We were not concerned with keeping at heat the enthusiasm and eagerness of those in whom loyalty and patriotism are instinct. Our job was to help keep the thought of the organization in something like a straight line of Americanism, to balance intelligent conviction against rabid fanaticism.

What we did towards winning the war wasn't much, when the aggregate efforts of the entire country are considered. (We are perhaps the only outfit on record not claiming to have won it practically single-handed!) But what we did do, and can do, to win and hold the organization to American ideals is—considerable.

OUTLINE OF WAR CLUB ACTIVITIES FOR NATIONAL FACTORIES

(1) Film, "Wake Up America." To be accompanied by a speaker from National Cash Register Co. It is suggested that factory managers engage a moving-picture house for the presentation of this film, which requires two hours to run off.

Immediately following the picture should be scheduled a brief talk outlining complete activities of the War Clubs. This talk should be made by factory manager or someone whom he shall choose and instruct. An important feature should be to impress on employees that *the winning of the war is infinitely more important than making lamps.*

(2) Within the next few days the factory manager should call together foremen and forewomen and designate them as group leaders, each to be responsible for the organization of a group of not less than ten nor more than twenty factory employees, to assure the reading of our booklets and attendance of employees at lectures and moving-picture exhibitions. It is suggested that the manager assign to each foreman or forelady the employees who shall constitute his or her group.

In some cases managers may wish to choose group leaders from volunteer welfare organizations already formed among our employees, or may wish to call employees together and ask for volunteers to act as group leaders.

(3) As soon as organization is complete, our first booklet, "What Is Wrong With Germany," and the Club buttons, should be distributed.

(4) During the third week may be scheduled the lecture, "Conquest and Kultur" (based on a booklet of the same name, issued by the Bureau of Public Information).

The speaker for the occasion may be obtained without expense through the local Patriotic Speakers' Bureau. These Bureaus are located in all of the larger cities. The Publicity Department will make arrangements for the speakers, if desired.

The lecture may be given at noon in the factory cafeteria.

(5) Following the lecture, our second booklet, "How Germany Brought About The World War," should be distributed.

During this week group leaders should examine each member of their clubs on the twelve questions contained in the back of the book, "What Is Wrong With Germany."

Each club member should be graded on this examination.

(6) During the fifth week the moving picture, "The Man Without A Country,"may be shown at some local motion-picture theatre. The picture may be obtained by the local moving-picture exhibitor. If there is a sufficient number of National Lamp employees to fill the theatre, it is suggested that the theatre be chartered for one evening. Otherwise the theatre may be open to the public, reservations having been made for National employees.

(7) During the sixth week may be scheduled for the noon hour a lecture ,"How The War Came to America." This lecture is based on a book of same title issued by the Committee on Public Information, and the speaker may be procured in the same manner as for the lecture discussed in Item 4.

(8) During the sixth week may be scheduled the motion picture, "The Little American." The arrangements for this film may be similar to those for the previous film as explained in Item 6 of this outline.

(9) At this time the third book of our war series, "Democracy versus Pan-Germanism," should be distributed and an examination on our second book,"How Germany Brought About the World War," should be conducted by group leaders, using the slips which will be provided to keep a record of grades made by each club member.

(10) During the seventh week a noon-hour lecture, "The Nation in Arms" may be scheduled. This lecture is made up from a booklet published by the Bureau of Public Information. Arrangements may be made as outlined in Item No. 4.

(11) Sometime during the eighth week arrange for showing the film "The Unbeliever," to be shown under the same conditions as outlined for the previous films in this series.

(12) Distribute our fourth war book, "What America is Doing to Win the War," and have group leaders conduct an examination on the previously distributed book "Democracy versus Pan-Germanism."

(13) Two weeks later have group leaders conduct an examination on fourth book, "What America is Doing to Win the War."

(14) The reports of four examinations, one on each of these four books, should be turned in by group leaders. These reports will show that each employee stood excellent, good, fair or poor on each examination.

To each employee whose total standing is excellent should be awarded a diploma with honors. To all who obtain an average of "fair" or "good" should be awarded a diploma.

One of the Many War-Study Classes Formed within the National Lamp Works

Mr. F. S. Terry (on his 1919 journey in France). With Mr. Terry are shown two of the French children to whom the War was such a grim reality, and whose misfortunes he and his friends did so much to alleviate. Mr. Terry and Mr. B. G. Tremaine, as managers of the National Lamp Works, were the prime movers behind the many war activities undertaken by the National

"Socks for Soldiers."—Inset shows Mr. B. G. Tremaine, under whose direction thousands of pairs of socks were knit. Mr. Tremaine and Mr. F. S. Terry, as managers of the National Lamp Works, were the prime movers behind the many war activities undertaken by the National.

Large photo shows Mrs. J. Cochrane, Pitney St., Cleveland, and one of her Sock-Knitting Classes.

Nela Park Red Cross Workers

THE SOCK LEAGUE

Not by any means the least among the hardships of army life was the long-drawn-out exposure to cold and dampness, which caused great suffering during the winter campaigns. It was in order to alleviate this suffering that the knitting of helmets, sweaters, socks and other garments became widespread in the United States, even before we entered the war. In the following pages will be told the story of the Sock League formed and financed by Mr. B. G. Tremaine, of the National Lamp Works management.

As early as October, 1916, Mrs. Isabella Caswell, a member of the Imperial Order, Daughters of the British Empire, called to see Mr. Tremaine regarding a movement to obtain woolen socks for the British soldiers. Plans were begun, appeals sent out, materials purchased, and in January, 1917, the first lot of socks was on its way to the soldiers. Following is an excerpt from Mr. Tremaine's letter presenting the need:

> "There is an urgent appeal from suffering Europe for comforts in the form of socks, etc., for those brave men who are giving their lives in this long and disastrous war.
>
> "I feel sure that there are many who are willing and anxious to take part in alleviating their misery, and who would become active if they knew what to do. Therefore, I am forming a Sock League, and personally will pay for and supply yarn and needles to these willing workers."

The Ready Response So numerous were the responses to this appeal that great quantities of yarn were purchased and stored on racks made specially for this purpose in the Administration Building. With the idea of "Only the Best" for the allies, an excellent quality of wool was bought. At first the knitting needles were purchased (at twenty cents a set), but after a while it became impracticable to buy them. From that time on, through the co-operation of Mr. Benbow, Manager of the Cleveland Wire Division, thousands of needles were made at the National's 45th Street plant and donated to the Sock League.

How the Work Was Handled To each knitter was given as much yarn as she requested, together with a set of needles and printed instructions. In cases where it was inconvenient for the knitters to call for the material, special messengers delivered it to them, and whenever necessary called for the finished socks. The enthusiasm of the knitters became most infectious: mothers, wives, sisters and friends of the National Lamp Works' department-managers and employees became interested, they interested others, and thus an endless chain was started, until the Sock League could boast a membership of eleven hundred. Miss N. L. Monroe and Miss E. A. Wendel assisted Mr. Tremaine in handling the many details of this work. It may be said of these young ladies that they conducted this activity as a serious and determined effort on their part towards helping our country in the war. As the socks were received, postcard acknowledgments were sent out, and the socks were carefully inspected in Mr. Tremaine's office. They were later re-inspected by the relief organizations to which they were sent—at first by the Daughters of the British Empire, and later by the American Red Cross. If the socks were not up to standard, they were returned to the knitters for repair, but "grandmother's" knitting as a rule was found to be a prize specimen. And, too, grandmother sometimes said she could not follow these "new-fangled" instructions—so the same style of heel used in the socks her husband wore during the Civil War was worn by some of the boys in 1914-1918. After the socks were inspected, each pair was pinned together and the socks packed for shipment, one hundred pairs to a carton.

The Sock League Becomes a Red Cross Agency From January, 1917, till September 19, 1917, all the socks were sent to the Daughters of the British Empire, but by the latter date the United States was actively in the war, and the knitters were notified that their socks would be turned over to our boys, through the American Red Cross.

The personnel of the Sock League varied from the debutantes who were "knitting instead of dancing this year,"to the nuns behind the convent walls. And the ages varied from eight to eighty-two. Boys as well as girls were knitting.

In addition to National Lamp Works employees and their relatives, the League included sewing circles of several churches and schools. A number of ladies who were interested in the Sock League volunteered to form knitting classes, and through the efforts of these earnest teachers thousands of socks were knitted. It happened more than once that local branches of the Red Cross were temporarily unable to get yarn and their workers were supplied from the "warehouse" of the Sock League.

Knitters in Many Cities

The fame of the League was not local—friends in other cities began to write for material. And, literally, that yarn of the Sock League traveled as far west as California, and as far east as Massachusetts. The League claimed members in forty-one cities and towns, and in thirteen states.

Two members of the League, Miss J. R. Gale and Miss L. Behlen, operated knitting machines, hundreds of pairs being made on these machines. It should be mentioned that the knitting machines did not turn out complete socks, however, as it was necessary to add the foot or the cuff by hand.

An interesting bit of knitting news came to Mr. Tremaine from Miss Margaret Rogers, daughter of Mr. H. B. Rogers of the Edison Lamp Works, who was knitting her third "double sock." By following special directions, two socks are knitted one within the other. Miss Rogers acquired such speed with this method of knitting that she did not think she would ever knit the single sock again. The original directions for the double sock came from an unknown lady in Australia; instructions were sold in this country at fifty cents a copy, the proceeds being given to the American Red Cross.

Some unique ideas were brought out in knitting. One lady knitted the letters "U. S. A." into the cuffs of a pair of socks. Some ladies would work a row or two of fancy colored yarn into the cuffs. This was done so as to insure the socks remaining in possession of their rightful owner. Another knitter patriotically purled the cuffs in red, white, and blue.

No Age Limit for Patriotic Knitters

One of the interesting and interested knitters was Mrs. Lovilla Williams, eighty-two years of age, who lived at Madison, Lake County, Ohio. In spite of her years Mrs. Williams knitted twenty-five pairs of socks for the League. One of Mrs. Williams' neighbors, Mrs. Frank Klasen, although a grandmother, made a record of which any person in the prime of life might be proud. Besides her regular work of milking six cows twice a day, doing all her own housework and much outside farm work, she knitted socks for our boys at the truly remarkable rate of a pair in four hours and ten minutes.

Mrs. M. W. Kirk of Fountain Creek, Tennessee, was paralyzed in the right hand, but knitted a pair of socks with her left hand.

Rewards of Merit

Besides the satisfaction that comes from a knowledge of duty performed, some members of the League received Red Cross Merit Badges, based on the number of hours of work. There were four kinds of badges, one a reward for four hundred hours, one for eight hundred, one for sixteen hundred, and one for thirty-two hundred. The Red Cross allowed eight hours for one pair of socks, in making its awards. Seventy-five members of the Sock League became the proud holders of badges, seven out of the seventy-five receiving the thirty-two hundred hour-badge. The cost of the badges was defrayed by Mr. Tremaine.

The Production Record

The knitters watched with interest the growth of their work from month to month. Their maiden effort was in January, 1917, when six pairs of socks were knitted, while their banner month was November, 1918—"Armistice Month"—when one thousand nine hundred and forty-four pairs of socks were turned in. A grand total of seventeen thousand three hundred and seventy-seven pairs of socks—enough to supply a whole combat division in the army—was the tangible product of Mr. Tremaine's Sock League.

In April, 1919, when Mr. Tremaine discontinued sending out yarn, he had on hand approximately one thousand and forty-two pounds, valued at approximately $3,127. This yarn was turned over to the War Relief Headquarters of the National Lamp Works, Cleveland, to be knitted into undergarments for the Children of the Frontier (see page 318).

RED CROSS CENTERS IN THE NATIONAL

MONUMENTAL ACHIEVEMENTS OF OUR GIRLS IN SEWING, KNITTING, BANDAGE-MAKING AND OTHER WORK FOR THE RED CROSS AND CHILDREN OF THE FRONTIER

Just as no history of America's part in the World War would be told fully without setting forth the "win-the-war" work of the American woman in Red Cross and allied lines, so no description of the war work of the National Lamp Works would be complete without full credit being given to the girls and women in the organization who so unselfishly, and entirely voluntarily, devoted their time to sewing or knitting, cutting and rolling bandages, canteen and other relief activities.

From the very beginning this work was put on a "business" basis, real production methods were in effect, and basing these on the unflagging interest of the girls, results were attained that ever since have been referred to with pride by the leaders of the various relief organizations.

NATIONAL GIRLS PRODUCE TEN PERCENT OF CLEVELAND'S RED CROSS OUTPUT

First in importance was the unselfish willingness on the part of the young women to donate their labor; second was the application to their work of the principles of organization. And this was the combination that enabled the National Lamp Works Chapter of the American Red Cross, located at East 45th Street, Cleveland, with a membership of about 900 girls, to produce ten percent of the total Red Cross output of the City of Cleveland. This was the combination that brought forth from this one chapter during the year 1918, 6,029 sweaters, 9,924 pairs of socks, 79,939 gauze dressings, 8,154 muslin dressings, 3,451 hospital garments, and 246 refugee garments, beside several thousand miscellaneous articles!

The girls who accomplished this worked five and one-half days a week making lamps. A light supper after their day's work in the factory was finished, and they came, cheerfully in earnest, to give three hours more to the work of aiding "the boys over there."

The National Lamp Works spent a considerable sum of money in helping its girls carry on the work—and the girls returned this sum to the Red Cross, in value of production, eight and one-half times!

In January, 1920, when many other groups of relief workers had disbanded, the young women of the National Lamp Works were turning out nearly one-half of the garments which were being sent abroad by the society "Children of the Frontier" for the needy children of the war-torn countries.

These are the highlights of a co-operative endeavor on the part of the employees and officials of the National Lamp Works to be helpful to their country at a time when help was needed. But the details of the story are no less interesting and may furnish to other companies, or to relief organizations, some material which may be of service, should similar activities be required again, either in war or in peace. For the girls themselves, as will be shown, and the National Lamp Works also, benefited in several ways, from this patriotic work.

There were scores of girls in the Lamp Works after the war who were making their own clothes, girls who less than a year before practically never had had a needle in their hands; for strange as it may seem, it was found that only a very small proportion could do plain sewing, about one in five, as nearly as could be determined. Nevertheless their instructors found out that nearly every girl could crochet or knit, in spite of ignorance of plain sewing. Few there were at first who could cut a garment, following a pattern, but later each girl, while perhaps not an expert, was able to sew enough to help considerably in the care or the making of her own garments. That was the employees' benefit.

From the company standpoint, the spirit or morale of the girls as a whole was improved greatly. Working side by side for months, they became bonded together through the spirit of their work to help others. One of the factory managers, discussing the time when the need for this work would pass, said, "Well, when that time comes, I must find some other similar work for the girls to do, some continuation of these classes, for I have found that they have built up a spirit among the girls of the organization which should never be allowed to lessen. I believe the fact that the girls were working together in a labor of kindness towards others, has brought about results which never could have been attained were they working for themselves alone. After this work is over, I hope I can find some local charity for which the girls can keep up their efforts, both for the good it does the girls themselves, and the good it does their morale."

Thus it will be seen that the Red Cross and Children of the Frontier work that was done by National girls showed three results—their production helped immeasurably in the work of relief during the war, and after; the good they did for others was discernibly reflected in benefit to themselves; and the spirit of the organization, the National Lamp Works, was intensified.

When the Red Cross work of the National was started, nobody foresaw to what proportions it would expand. Fortunately, the system under which it was established was one which permitted it to grow to the fullest extent with the minimum of trouble. The cost to the National was measured in these terms, as they were expressed early in the endeavor by Mr. F. S. Terry, manager of the National organization. He said, "I do not know how much money we should spend in this work. If we spend a certain sum, and the girls will return that four times to the Red Cross in production, I will consider the money well spent, and that the girls have done their share."

Money, and more money, was spent, but the girls doubled Mr. Terry's estimate of what would have been a satisfactory output, for during the time of greatest need, the year 1918, they returned the money in output eight and one-half times.

NELA GIRLS GET UNDER WAY

The Red Cross organization throughout the United States was at work before America entered the war, in 1917, but it was from April of that year, when our country took up arms, that the enormous value of this "home branch" of the service really became apparent, finally doing such good work that it brought words of highest praise from General Pershing himself. It was in September, 1917, that the National Lamp Works, as an organization became active in forming Red Cross classes among the employees, a large proportion of whom are women.

The Red Cross work in question was an activity of the National Service Department (Mr. A. V. Simis, manager), and was put under the direct charge of Miss Rose Streifender, who had shown considerable ability in organization work.

The first classes formed were at Nela Park. Several hundred girls were quick to register, and ready to receive training in making surgical dressings, for which at that time there was urgent need. The gymnasium was divided into four "surgical dressing" rooms, made entirely sanitary, and instructors were sent out from the teaching center of the Red Cross. All of the training was given here, under the direction of Mrs. Charles A. Otis. Here seventy-five girls, working four hours a week on company time, trained until they were qualified as instructors, able to take charge of classes of their own.

From that time on, the work of the Nela Park girls was done at "Taylorhurst," a large house used by the East Cleveland chapter of the Red Cross. Here the National classes, composed of National employees only, and instructed by National employees, met three nights a week, the Company paying a proportional share of the expenses of keeping Taylorhurst open. The classes averaged forty-five girls a night in attendance, and operated as an auxiliary chapter of the Red Cross, turning in their output through the East Cleveland chapter, but receiving individual credit.

The greater part of this work was in making surgical dressings, for which there was urgent need, and officials of the Red Cross Surgical Dressing Division stated that the Nela Park girls turned in the best dressings made in the city of Cleveland. *There was never a case where a dressing made by these girls failed to pass the inspection officials.*

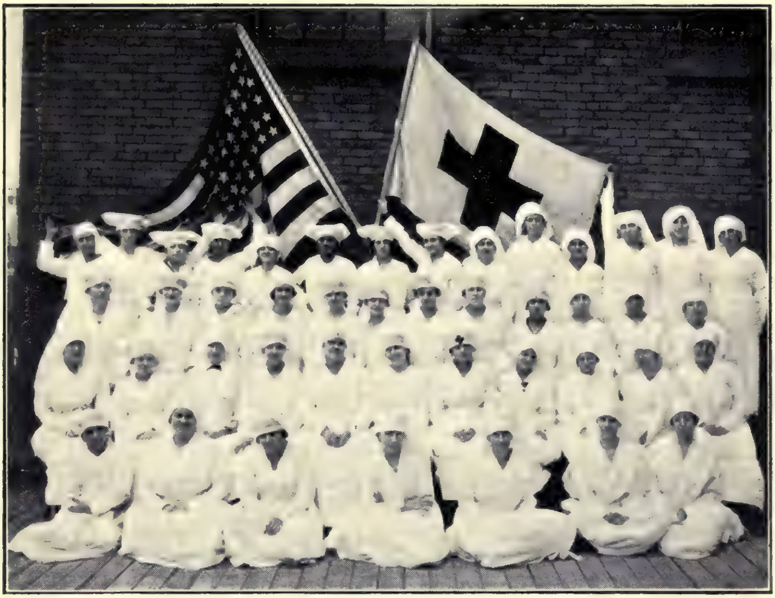
Later came the call for influenza masks, and these the girls turned out as efficiently as they had the surgical dressings. Many of the young women, in addition to their work at Taylorhurst, did a large amount of knitting, and it was to this line of work that nearly all turned after the East Cleveland chapter was closed, about a month after the armistice was signed. The Nela Park branch stood high in all of the knitting contests that were conducted, two hundred and three girls knitting regularly.

As the work enlarged, the National furnished a light supper to the girls before they began their evening work.

Deaf-Mute Red Cross Workers of the Cleveland Mazda Lamp Division's Stem Department

NATIONAL LAMP WORKS
LAMPS TO LICK THE KAISER

A Parade of National Lamp War Workers at East Forty-fifth Street, Cleveland



Red Cross Workers at East 152nd St. Properties, Cleveland

Red Cross Workers at the Sterling Electric Lamp Division
Warren, Ohio

Later on, those who had served seventy-two hours were given a banquet at the Winton Hotel, where appreciation of their work was expressed by Miss McCune, a Red Cross worker from overseas, Mr. Joseph E. Kewley of the Law Department of the National, and Mr. Albert V. Simis of the National Service Department. It was found that a dinner where the girls could all be together and hear the results of the work they were doing, or see a few prizes given to the best workers, meant much in keeping their spirit at highest pitch. Not that they would consciously have let down in their work otherwise—they would not have, but an occasional social gathering certainly made their work seem easier.

For the year 1918 the output of these Nela Park girls was:

Gauze dressings	62,350
Muslin dressings	445
Refugee garments	46
Sweaters	617
Socks	291
Miscellaneous knitted goods	121

(25% of the knitted goods listed above were produced by girls at the company's East 152nd Street plant.)

45TH STREET RED CROSS CHAPTER BECOMES LEADER

While this work was going on, there had been developing at our 45th Street properties a Red Cross chapter which eventually became our largest relief-work center. The 45th Street properties consisted of seven manufacturing divisions, employing approximately 2,100 girls.

In October, 1917, knitting classes were formed in the various divisions, meeting after working hours in the various rest rooms provided for the girls. 1,700 people signed up for the work at the start, and the classes were held five nights a week, each girl reporting once a week. By no means all of the knitting was done in the rest rooms, however, for the girls took home their yarn and on other evenings turned out large amounts of work. Red Cross knitting instructors trained the girls, and at intervals speakers addressed them on wartime subjects and in that way they could understand how much real good their work was doing.

Later, when the knitting was in full swing, Mrs. Homer McKeehan, in charge of all Red Cross knitting in Cleveland, wrote that the work done by these girls was the best in the city of Cleveland.

So remarkable was the quality and output of knitting, that the plan was suggested that surgical dressings work also be included. Near the 45th Street plant was a sixteen-room frame house owned by the National Lamp Works. Half of this house was pressed into service, made sanitary to the extreme degree necessary for this class of work, and here the girls started on muslin dressings and hospital garments. The work expanded so that within a few months it was necessary to take the whole house.

But there seemed no limit to the amount of work the girls could turn out, with instructors trained from their own ranks, and working in nightly shifts. Long before, the attention of the Red Cross officials had been drawn to this center of relief, and it was not strange, therefore, that Mrs. E. S. Burke, Jr., chairman of the Cleveland Chapter of the Red Cross, asked if the girls would be willing to have a quota assigned to them, like those given to the various Red Cross chapters throughout the city. This meant that when the call for a certain production was made on the city of Cleveland, each Red Cross chapter would be assigned its proportion of the work, and would be practically in honor bound to see that it was accomplished.

NATIONAL'S RED CROSS HEADQUARTERS SHOWS ITS METTLE

The plan was adopted, and in February, 1918, the Red Cross chapter flag was raised and the organization of National girls became indeed a part of the Red Cross organization.

At that time an urgent call for sweaters was received by the Cleveland district. They were needed within two months, and quotas were given with that time limit on the production. The assignment given the National Lamp Works chapter was 1,000, and while it seemed like an impossibility to turn out this number in the time allowed, the end of the two months saw not only the 1,000 sweaters asked, but 400 additional.

This accomplishment paved the way for even heavier quotas, but not once did the girls fail to meet their mark. *In fact it was practically a fixed plan to give the National chapter a quota of 9.8% of the whole task set the city of Cleveland, and in every case the quota was not only met, but was exceeded, for the usual production ran between 10 and 11 per cent of the output of the whole city.* Taking the knitting alone, the figures taken from the official records show that the production of the National girls, and the friends they pressed into service, amounted to 14 per cent of the city's output.

During the war, the chapter roll-call showed 900 active members. Friends and relatives who showed continued interest in helping out in the work were admitted to membership, and during the day, while the girls were at their lamp-making labors in the regular plants, seven sewing clubs of women relatives and friends met at the chapter house. At one time there were no less than 800 persons on this list of outside workers.

At this chapter, as later at Nela Park, the company provided a warm and substantial meal for those who wished to go direct from their regular work to the Red Cross headquarters.

When the call for gauze dressings was at its height, a room was specially fitted up in the 45th Street chapter house for this work, and seven surgical dressings classes were formed from employees of the 45th Street, 152nd Street, and Nela Park plants. These girls, like the earlier workers in this line at Nela Park, were specially trained by Red Cross instructors, and they continued at work until the call for surgical dressings was at an end.

ST. LOUIS WORKERS MAINTAIN THE PACE

So successful had been the plan at the Cleveland plants of the National that it was decided to try it in other National Divisions, and early in 1918 the St. Louis Mazda Lamp Division took up the work, concentrating on muslin and gauze dressings. The same method of organization was used, the girls were trained under the same system and 300 joined the classes. Their output kept up to the standard the National had set.

The Red Cross chapter of National girls in Cleveland did not confine itself to the lines of endeavor that have so far been described. Miss Streifender and Miss Mary A. Corns, her assistant, who later was a victim of the influenza epidemic, took the course in Civilian Relief, and established a branch of that activity in connection with the chapter work. In all, 175 cases were handled, nearly all of the work naturally falling among families where a boy was in France. A general information bureau was maintained at the chapter house. Some of the other activities entered into by the girls are listed elsewhere in this text.

CLOTHING CHILDREN FROM THE FRONTIER TOWNS

After the armistice was signed, but before the Red Cross gave up active chapter work, request was made that girls help out in making garments for the Children of the Frontier, a society which was caring for thousands of unfortunate children from the devastated areas in France. The girls willingly agreed to devote to this purpose all of the time that was not taken up by the Red Cross work. Later, when the Red Cross drives were over, practically all of the time was given to the Children of the Frontier. This activity continued into 1920.

The full change from the Red Cross to the Children of the Frontier came in March, 1919, the St. Louis Division also joining in the new work. Moreover, additional plants were interested, and in March the Illinois Miniature Lamp Division (Chicago) joined, while in the following month the Minnesota Mazda Lamp Division (Minneapolis) also formed its sewing classes. But in making the change the Red Cross was not neglected, for in the first six months of 1919 more than 8,000 garments were made for that organization. In June, however, the Red Cross calls ended.

In the Children of the Frontier work, each Lamp Division specialized on one type of garment. Chicago and Minneapolis girls did a lighter class, while at St. Louis heavier types were made. But in each plant every girl was so trained that she could readily make any type assigned, in case of emergency, and also that each might have as thorough training as possible.

At the Cleveland headquarters two power buttonhole machines and two button machines were installed; on these one girl could turn out approximately fifty-five buttonholes a minute, or sew on forty buttons.

All garments made in the outside plants were therefore sent to Cleveland, where these operations were completed and the garments then forwarded to New York for shipment abroad. In the latter months of 1919 from twelve to seventeen bags of garments were sent out of Cleveland each week, and each bag contained no less than 78 garments. In November and December about 60% of the garments sent to Europe by the Society for Protecting Children of the Frontier, were made by National girls.

But even through the time devoted to work for the Children of the Frontier, knitting did not cease, for this society also had great need of knitted goods, especially stockings and sweaters of various sizes for children under the age of sixteen. Not only did the National girls continue in this work, but the outside knitters helped also, the number of workers totalling 1,137. This list included many persons who had been knitting socks of yarn furnished by Mr. B. G. Tremaine (see page 307).

An organization within the National Lamp Works chapter of the Red Cross, known as the Red Cross Club, did much toward accomplishing the gratifying results already mentioned. Membership in this club was purely an honorary matter, the requirement at the time of the club's formation being the completion of two hundred hours of Red Cross work. This requirement of work accomplished was made variable, increasing as time went on, so that at the date this account was written, a girl must have completed five hundred hours to be eligible. The membership as of January, 1920, averaged about eighty girls. There was also a branch in the St. Louis division, but the requirement in hours there was not so high as at Cleveland, for the work had not been in progress so long.

Club rooms were fitted up for the members, who paid dues of twenty-five cents a month to cover the cost of entertainments they gave. Meetings were held every two weeks for the purpose of obtaining suggestions for the improvement of the work, and at every second meeting the girls were addressed by some outside speaker of prominence.

In helping to meet the heavy quotas that were given, the club was of the greatest assistance, as each girl was pledged, in addition to giving three and one-half hours a week regularly to the work, to add additional time enough to make sure that the chapter as a whole met whatever quota was set for it.

In the summer of 1919, the club members were given recognition for their good work by being entertained for a week at Nela Camp, where they lived in tents and enjoyed a real outdoor vacation. This camp was held at the expense of the company, and the girls received their regular pay for the time they spent away from their work.

Some of the accomplishments of the individual workers are interesting. Early in the war Miss Mae Cipra received a letter from her brother in the service telling her of the valuable work the Red Cross organization was doing for the soldiers. As a result Miss Cipra throughout the duration of the war spent five nights a week working at the Red Cross chapter house, in addition to doing a large amount of outside knitting. Miss Alma Heinz, another chapter member, was probably the best knitter in the organization. During the time hostilities continued, Miss Heinz specialized on knitting sweaters, and for the whole period of the war her output averaged one sweater every three days. Mrs. A. L. Maddell, wife of one of the National employees knit a pair of socks a day during the whole period of the war, and after the war ended kept up her splendid work for the Children of the Frontier. Her yarn requirement was usually a bale every three weeks. Mrs. J. L. Dana, also wife of a National employee, could knit a sweater in 8½ hours. The list of girls who worked three nights a week during the war was a long one.

HOW YOUNGSTOWN GIRLS AIDED THE RED CROSS

Relief activities in the National Plants outside of Cleveland took various forms. The Youngstown Mazda Lamp Division, at Youngstown, Ohio, took an active interest in Red Cross work. In October, 1917, the girls at this plant formed a Red Cross class of 150 members to make surgical dressings. The class was supervised by Miss Sutherland, Service Secretary, assisted by twenty-five girls who took a special course from the local chapter of the Red Cross. These girls served as teachers and inspectors, and through their efforts the surgical dressings produced by the class were of the very best workmanship, the girls receiving many compliments from the local chapter for their work.

Parade of Miniature Bulb Division's Red Cross Contingent

Busy on Red Cross Work at the Youngstown Mazda Lamp Plant, Youngstown, Ohio

Miss Alma Heinz
Champion Knitter of the
National

One Week's Knitting Output. Made by the National's Red Cross workers in Cleveland during the summer Knitting Drive of 1918

The "Red Cross Club."— At the Right is the National Lamp Red Cross Headquarters House

The class remained in active service, putting in two hours of evening work once every week until October 14, 1918, when it was closed by order of the Health Board, on account of the influenza epidemic. When this ban against public meetings was lifted, the local chapter of the Red Cross announced that it would not need further supplies.

The record of the girls' production was:

4 inch x 4 inch Compresses	100,000
9 inch x 9 inch Compresses	28,000
Sponges	5,000
Heel Rests	1,000
Surgical Pads	1,000

In addition there was formed a knitting class, with fifty members. These girls had a regular schedule for evening work, and many did a great amount of knitting at home. They produced 100 pairs of socks, 75 sweaters, 100 scarfs and helmets, and 25 pairs of wristlets.

In September, 1917, the girls of the Youngstown Division held a dance, and the proceeds, $81, were turned over to the Red Cross. In December a bazaar was organized, running for two days. The whole Service Department, including cafeteria and rest rooms, was utilized, being decorated and set with booths. The affair was a great success, bringing in a total of $656, which was donated to the local chapter of the Red Cross.

Practically every girl was a member of the Red Cross, paying the $1.00 membership fee. Nevertheless when in June, 1917, a special Red Cross campaign was held, the girls subscribed an additional amount of $700. The Red Cross classes participated in all of the Youngstown patriotic parades. In a Fourth-of-July parade, the entire unit, about 200 in number, was in full Red Cross uniform, and divided into squads, which had been coached by competent instructors in formations and marching. This lamp-factory Red Cross unit was awarded first prize for the finest showing in the Red Cross division of the entire parade.

Some of the work at Minnesota Mazda Lamp Division has been described, but there were additional activities that should not be omitted from notice. When the June, 1918, Red Cross campaign for funds was on, practically every employee of the factory worked one Saturday afternoon, and donated their earnings, $477.63, to the Red Cross. The employees' committee, which this Division appointed to keep in touch with those who entered the service, has been mentioned on page 144.

WITH RED CROSS GIRLS AT OTHER NATIONAL PLANTS

At Mahoning Miniature Lamp Division, Warren, Ohio, about twenty girls interested themselves in Red Cross work, producing 50 sweaters, 8 scarfs, 8 helmets, 4 washcloths, 7 pairs of wristlets, and 40 pairs of socks. The girls of this Division contributed about $250 to various relief organizations. At Puritan Refilled Lamp Division, Providence, R. I., thirty girls attended the Red Cross surgical dressings class, devoting one evening a week to this work; at the sales office of the Sterling Electric Lamp Division, Warren, Ohio, the girls formed the local surgical-dressings division of the Red Cross, a class that finally reached a membership of 200; from the sales office of the Banner Electric Division, Youngstown, five girls, out of a total of seven, worked in the Red Cross class at the Youngstown Mazda Lamp Division, whose work has already been described.

ONE YEAR'S RELIEF WORK OF NATIONAL LAMP GIRLS IN CLEVELAND

1918 KNITTED GOODS

Sweaters	6,646
Socks (pairs)	10,215
Miscellaneous	1,668

1918 DRESSINGS

Muslin Dressings	8,599
Hospital Garments	3,451
Refugee Garments	292
Gauze Dressings	142,289

SUNDRY WAR WORK OF THE RED CROSS GIRLS FROM CLEVELAND PLANTS OF THE NATIONAL

Collected tinfoil worth $250.

Lawn fete for Victory Chest netted $487.

Carried flag for Sousa's band, collecting $1,700 for the Victory Chest.

Sold Thrift Stamps to value of $1,000 at Wade Park Pageant.

In Third Liberty Loan drive manned booth and sold $5,500 in bonds.

Gave bazaar for Children of Frontier; proceeds $1,300.

Sold Thrift Stamps at Euclid Beach.

Collected two barrels and two baskets of peach stones for gas masks.

Sent two barrels of clothing to Belgians.

Attended all Red Cross and Liberty Loan parades.

Established Civilian Relief branch and investigated 175 inquiries.

At Christmas, 1918, filled 500 gift boxes for soldiers from Cleveland who were without relatives. The company donated 100 additional boxes. The needs of the city were 6,000 boxes, so that the National organization furnished 10% of the total.

NELA FUND

Nela Fund, for French war orphans, widows and soldiers, was founded by Mr. F. S. Terry in 1917, and was under his personal direction. The outstanding feature of Nela Fund, and the one which differentiated it from most other institutions of relief, was the touch of personal interest which it injected between the benefactor and recipient. It made each contributor realize that he was assisting in the welfare of a human being who stood acutely in need of an interested friend; it was able to do this because it investigated thoroughly the recipient's needs before soliciting a subscription for his or her maintenance.

Nela Fund not only raised and transmitted the funds, but also encouraged frequent correspondence between the orphan and the donor; furthermore, it provided the services of expert translators, who translated from French to English or *vice versa*, the letters thus exchanged. All such service was rendered by Nela Fund without cost to the subscribers.

The name Nela Fund was adopted merely for convenience; the Fund had no official connection with the National Lamp Works. The success which the Fund enjoyed, however, was largely the result of the financial and personal interest which managers and employees of the National Lamp Works manifested in this unusual and specialized method of direct aid to widows, orphans and soldiers. It was to the lamp organization that Mr. F. S. Terry looked for assistance in the bountiful work he had instituted, and, as in all activities of war-time importance, their services were of the utmost value in carrying the project through to success.

When France was called upon in 1914 to defend her land, she recognized the seriousness of the problem of providing for the multitude of war orphans and widows who would be left in utterly stringent circumstances, and the French Government immediately took steps to aid these innocent victims. But in time of war, men and munitions are the crying needs of a nation, and so France was compelled to finance her fighting program more liberally than her relief program. The enormity of this problem, and the expense involved, was such that as late as June, 1917, the French Government was allowing but eight francs a month for the maintenance of orphans deemed needy, regardless of the varying needs of the individual.

The intervention of the French and American charitable organizations, which sprang up simultaneously with the first sign of hostile fire, was a step towards solving France's problem of caring for her homeless and destitute. But these relief agencies were for the greater part general in scope and though their source of income was large, their field of endeavor was so extensive that to render aid of more than an impersonal nature was beyond their power. Further, their gifts, though abundant, were in no measure large enough to supply all the needs of these thousands upon thousands of innocent victims, no two alike; no two calling for the same measure of relief and comfort.

There can be no variance of opinion as to the class of people suffering most acutely in the war. It was the families of the middle cultured class, who stood for the best ideals of France, and who in many cases had built up comfortable incomes for themselves, that were compelled to make the greatest sacrifices. Thousands of them had investments in the invaded districts—utterly destroyed. With the breadwinner killed in battle, and the family income cut off, many a delicate mother found herself left with a large family of children and no means of supporting them save by manual labor, for which she was utterly unfitted. The war, then, in many cases meant the breaking up of homes and lost opportunities for the children—the very "flower of France"—who were suddenly denied the education which was important to insure their success in later life.

As early as March, 1916, the attention of Mr. F. S. Terry was directed to an orphan, twelve years of age, brought by the war into a condition similar to that just suggested. This boy had been securing educational advantages and everything pointed to a prosperous future for him. Then the tragedy of war ensued and, like thousands of the best manhood of France, his soldier-father fell. There arose a dark cloud on the horizon, for suddenly and cruelly the prospects of the liberal education which the father had in mind for his son were changed to faded possibilities.

HELPING FRANCE AND ITS ORPHANS

Mr. Terry saw here a chance to assist both a deserving family and a country which was fighting not for itself alone but for the freedom of all mankind. The family in question, like all others of the better class, deplored charity and would have refused financial assistance had it not been given in an interested spirit and for the good of France. With the aid of a French charitable organization which vouched for its needs, Mr. Terry wrote to this orphan and members of his family. He learned through letters to the boy's mother of her means and needs for keeping and educating her son; he extended to her the appreciation of the American people for the hardships which she and the people of France were bearing so heroically, and he later advised her of the plans and preparations which America was making to aid the allies. As these letters were circulated and read by others, they tended to stimulate the morale of the French and to cement the spirit of friendship between the people of the two countries.

The widow, in reply, wrote of her family, telling of her husband who had died for France and freedom, what his death meant to her and her son, and how her family might be held together and educated. She told of the heroic stand which France was making for humanity, of conditions in the fighting area, and expressed joy at hearing of America's feeling toward France. These letters were valuable to their readers, both in the United States and France, for they gave first-hand the conditions in each country.

Thus this family, through the gift and interest which an American had extended to them, was able to "carry on" in a normal way. Each letter from France convinced Mr. Terry more and more of the valuable mutual benefits being derived from this interested form of relief. Notes from the orphan told of his progress at school and of the happy moments spent with his mother, who was keeping from his mind as best she could the sorrow within her own heart and the heart of France. At the very moment when the manhood of France was fighting to save the country from the Teutons, the gift of the American was helping to build up the mind and body of this future citizen who otherwise would have been handicapped. The picture of a grateful mother and a happy boy was felt by Mr. Terry to be a handsome return on his investment, and so he invested more. Family upon family was added to his list until thirty-four orphans in seventeen families were receiving a cheer and a boost which otherwise would have been impossible.

FROM A WIDOW OF FRANCE

The following letter is typical of those written by French widows, and shows something of the profound needs of these widows and their gratitude for the interest taken in their welfare.

> "I have received through the agency of the Saint Cyrienne your very generous gift. I am touched by the fact that you are so good as to take an interest in my children. I thank you very much for the material aid which you bring into their lives and to their education. Thanks to your generous devotion, my children will again find some of the comforts which they had lost through the

death of their father. I should love to express better than I do my very deep gratitude. Know only that you have been the cause of one of the rare joys I have experienced these three years. The changed conditions of my life cause me little uneasiness for myself; but I felt wretched at the thought that the miseries of the war should reach my children, not only in their affections, but in upsetting their whole material existence. But your generosity has given me real happiness, and I thank you not only for them, but also for myself.

"My husband, the son of an officer, was a lieutenant of chasseurs on foot at the outbreak of the war. He had been admitted to the War College the first time he applied, a thing rather unusual. A brilliant officer in time of peace, he evinced in the war admirable qualities of heroism. Being wounded on August 24, 1914, he assumed command of the company which the captain had to relinquish on account of a severe wound. He had the willpower to remain at this post for days, although his wounded leg troubled him much. He was appointed Captain on the 31st of August. On September 6th following, a bullet cut off part of a finger while another went through his jaw; yet he refused to be sent to the rear. On September 8, because he was exhausted by these various wounds, he was going to retire to the rear, when his company and the neighboring one were ordered to defend an important position. There was no one else except a very young second lieutenant to assume command. Gathering once more his strength, my husband took the lead, and it was during this night of September 8, that a last wound overcame his courage. What he did was all the more admirable, because he was by no means a fanatic, but a cool nature, reasoning out the consequences of his deeds. I may add that giving up his life was an immense sacrifice, for life in our family meant happiness.

"And that was not the only sorrow that befell my children. Their grandfather, my father, was killed at the Dardanelles, he being a brigadier-general. He had been a soldier from the day he was old enough to join the army. A volunteer of the war of 1870, he had since made several campaigns in Tonkin, at Madagascar, etc. It was by accomplishing bravely his duty as a chief and by exposing himself in order to save the lives of his soldiers, that he was killed in June, 1915.

"Aside from these losses, the war has wrought its ravages about my very fireside by destroying even the mementoes of a happy life. I was driven out of St. Mihiel, where my husband was garrisoned, by the coming of the Germans. I fled with my little Ginette, then three years old. My son was born four months later. I learned from refugees of St. Mihiel that the home I occupied had been completely burnt. I have since seen, on photographs taken from airplanes, that their story was but too true.

"You see, therefore, that in three years' time, my children have witnessed many tears shed about them. I am grateful for the renewed faith you have brought them; for the help you give me in making their childhood more happy."

SOCIETY OF NELA MUSTERED INTO ACTION

In 1917, after promoting this work alone for two years, Mr. Terry realized he had reached the apex of his individual possibilities for carrying on correspondence. Knowing that thousands of widows and orphans might be given personal aid and thus be relieved of many heavy burdens, Mr. Terry decided to call upon his associates. Consequently, at the summer meeting of the Society of Nela at Association Island in June, 1917, he explained in detail the work he had been engaged in, and outlined his plans for futhering it. He told the history of some of the children whom he had adopted, and read letters illustrating how wonderful the benefits were and the gratitude of these children and mothers. This was sufficient evidence for the Nela members, who immediately subscribed in "water-bottle money" and I. O. U.'s several thousand dollars, and promised their active support in a campaign to interest others. This campaign took definite form at the Christmas season, and was known as the Christmas Drive of 1917.

So was born the Nela Fund for handling the subscriptions and acting as a medium between the benefactor and the orphan he "adopted." Between the summer conference of 1917 and the opening of the Christmas Drive, Mr. N. H. Boynton, then manager of the Publicity Department, was named by Mr. Terry as active head of the extension campaign.

The organization of the Fund and the method of soliciting and transmitting funds are worthy of note. Headquarters were established in Room 2044, 120 Broadway, New York. Mr. Robert L. Stevenson was appointed secretary of the Fund and Professor J. L. Borgerhoff was engaged as translator. It is to be kept in mind that a big factor in the Nela Fund relief was the personal correspondence carried on between the French families and their American "godparents." It is interesting to note in this connection that in the first twenty-seven months of its operation over 3500 letters were received and translated from English to French and from French to English by Nela Fund.

The needs of orphans varied with age and educational requirements, so that the party interested could subscribe for the maintenance of children whose expenses for a year's keep, either with their mother or in private homes, would vary from $36 to $250. The usual amounts asked were $36 to $40, $50 to $60 or $200 to $250.

BRINGING CHEER TO "SOLDIER-GODSONS"

The cost of maintaining a soldier-godson ranged from $20 to $30 a year, while for the re-education of a mutilated soldier from $80 to $200 a year was needed, according to the trade he was learning. The soldier-godson movement was of decided importance because the French soldier received but five cents a day for his military services, and was in need of many comforts which would enable him to bear his trials with lighter heart. The following letter from an adopted godson shows the changed expression which was made possible by a personal-interest contribution from a Nela Fund subscriber:

> "For the present I feel almost happy, for I know that a good man is kind enough to take an interest in me. I assure you, my dear godfather, that I am proud of the friendship you kindly give me. Being entirely without news from my parents and my dear little boy, who are all in the invaded part of Belgium, I assure you, my good godfather, that I really felt too lonely, and that my lonesomeness was the cause of my discouragement, which, in turn, though only temporary, affected my health. Now that I am sure of having found a good friend, I am entirely different. Your letters have cheered me up to such an extent that I am in the best possible mood to finish, as I ought to, the task I have voluntarily assumed. Thanks to you, my dear godfather, I shall overcome everything that comes along, and more still, for I tell you that I am ready for any sacrifice."

The sum subscribed for maintaining an orphan, widow or godson could be paid into the Nela Fund in any manner desired by the donor, so long as the entire amount was forwarded within a year. Unlike the ordinary organization of relief, Nela Fund did not deduct a proportion of the subscription to meet overhead expense. This was borne partly by Mr. Terry and partly by contributions made especially for that purpose. Another essential characteristic of the Nela Fund operation was the promptness with which money was forwarded to the beneficiary. When a subscription was accepted for an orphan, the mother or guardian was immediately notified and told that a semi-annual payment would be placed to her credit at some bank named by her, or a French clearing house, on a specific date. This was done even though the amount for the support of the orphan had not been received at the headquarters of Nela Fund. By so doing, no burden of anxiety was ever laid upon the recipient.

BECOMING A GODPARENT

The reader may wonder how the godparent chose the orphan, and what security he had that his gift was doing its share for good. Nela Fund co-operated with certain reliable French charitable institutions with which Mr. Terry, through two years' personal observation and dealings, had established relations. These agencies were interested in widows and orphans of the middle class. They had on file pictures and histories of thousands of deserving unfortunates, which they willingly placed at the disposal of Nela Fund. Whenever a subscription was entered at the New York office, the picture and history of two or more orphans, whose requirements were within the amount subscribed, were forwarded to the interested party, who made his choice and returned the unaccepted history. The donor then began to communicate with his godchild, and thus started an interesting and helpful correspondence. Corresponding was optional with the giver and would be taken care of, upon request, by the Nela Fund.

Some of the French organizations with which Nela Fund worked hand in hand were the Saint Cyrienne, National French Association, Fatherless Children of France, Children of the Frontier, La Federation Nationale D'Assistance aux Mutiles des Armees de Terre et de Mer, and the Association Valentin Hauy. These organizations were of the highest calibre; a few words concerning their activities may be of value.

The Saint Cyrienne was a friendly association of students and former students of the military academy of Saint Cyr. At the outbreak of the war its able members were called to the colors. On the battlefields many made the supreme sacrifice, and somewhere back of the lines were left families which the widows were wholly unprepared to support, unaided. The Saint Cyrienne, however, did not forget the widows and orphans of its fallen members. It made inquiries into the needs and means of each family, gave of its own funds whatever was available, and then strove in other ways to provide that physical and educational nourishment which neither the government nor itself was fully able to supply.

Then there was the National French Association, organized for protecting the families of those who died for their country. This association aided thousands of widows and orphans by soliciting through its many offices the means necessary to support and educate them. There were the societies of the "Fatherless Children of France" and the "Children of the Frontier," which had aims similar to those of the National Association; their accomplishments were equally noteworthy.

La Federation Nationale D'Assistance aux Mutiles des Armees de Terre et de Mer was a society having for its purpose the re-education of mutilated soldiers. This body under the active presidency of M. Bartlow, a former Prime Minister of France, found means to re-educate thousands of mutilated soldiers and to offer them remunerative employment.

The Association Valentin Hauy concerned itself with the welfare of the blinded soldiers. Founded in Paris in 1784, by Valentin Hauy, the association was directed principally by the blind. In its museum is a wonderful collection of the work of those it aided, and of the machines on which they worked.

How the Nela Fund Was Advertised

Interest in the Nela Fund was promoted principally through booklets, general and personal letters and to a limited extent by newspaper articles. Three booklets were published concerning the Fund, the titles being:

1. The Purpose of Nela Fund.
2. Interested Charity.
3. Your Debt to France.

The first two were distributed during the Christmas Drive of 1917 and "Your Debt to France," during the 1918 drive.

To enlighten National employees upon the things which Nela Fund subscriptions were making possible, and to keep them informed of developments from time to time, general letters were used. These letters were largely educational in nature, quoting expressions of gratitude from the French widows, orphans and soldier-godsons. Besides their importance as conveyors of information, such letters were of value in keeping aflame throughout the year the aims and ideals of Nela Fund, and served as a reminder that the needs which the Fund met were urgent and constant.

In addition to the National Lamp people, Nela Fund had as contributors and sponsors many representative business men and investigating bureaus of this country and abroad who were glad at all times to give information concerning the Fund's organization or policies. In "Your Debt to France" appeared such a list; it included Hon. Myron T. Herrick who, as American Ambassador to France during the early years of the war, was in a position to know the needs of the people in the war-torn regions.

From the 1917 summer conference to the opening of the Christmas Drive, 213 subscriptions were obtained, largely through the efforts of National managers and employees. This constituted an excellent introduction and working basis for the Christmas Drive, and illustrated better than words the profound need which Nela Fund was meeting.

THE 1917 CHRISTMAS DRIVE

DECEMBER 17 TO DECEMBER 24

The plans for the 1917 Christmas Drive were well worked out before the campaign itself opened. The responsibility for success rested on the shoulders of the members of Nela who had pledged their unreserved support at the summer conference. The goal for the Drive was placed at $25,000, which amount would provide for approximately one hundred stricken families during the year 1918. A quota of $250 was allotted to each Nela member as the amount he was to raise.

"IT PAYS TO ADVERTISE"

The drive opened with vigor and determination on the part of the National managers, who devised and promoted their own "sales" campaigns. A few subscribed their entire quota personally, but the majority strove to interest others over and above making their own subscriptions. Department meetings were called, "clubs" were formed, managers and employees became so interested as to approach acquaintances and strangers with equal zeal. Among the novel advertising plans was one concocted by Mr. Fred P. Harris, manager of

Purchasing Department. He first secured a photograph and history of an attractive orphan, whose story he told to all those approached by him in the work of the Fund. Then, to arouse the curiosity of people entering his office, Harris had a placard printed—"Ask Me What I Know About a French Girl." This was prominently displayed and served its purpose well. Mr. J. T. Fagan conducted an "apple raffle" in the Nela Cafeteria, Mr. R. E. Scott promoted a campaign among the members of the Harvard Club of Cleveland, Mr. W. D. Frank of Nela Press "sold" to the Ben Franklin Club, while Mr. J. P. Goggin was very successful in interesting the Cane Glass and Tubing Union.

Factory employees entered into the spirit of the drive with equal determination. The employees of the Puritan Refilled Division and the Boston-Economy Lamp Division voted unanimously to work two Saturday afternoons, which they would otherwise have had open, and to contribute the wages thus earned to the Fund. The Oakland factory set a Nela Fund Day on which all foremen and operators strove for extra production and their entire day's wages were contributed to the orphans. These were a few of the many methods used in the campaign to interest National employees and persons outside of the National in the "grateful investment" Nela Fund had to offer. Amounts of subscriptions written up were announced from campaign headquarters daily, successful plans for securing subscriptions were exchanged and through the newspapers and in many other ways interest was fostered in the work of the drive.

The harvest of subscriptions was gratifying. To families across the sea it meant the lightening of heavy hearts, to Nela members it was the fulfillment of an accepted pledge, to Mr. Terry it was the pleasant realization that the Fund was an assured success and to every subscriber it was a matter of wholesome satisfaction to know that Christmas Day, 1917, was more than ever before a day of practical giving. Subscription acceptances did not cease with December 24th, however, for January, 1918, brought in contributions totalling $3000. When Christmas Drive books were closed, March 11th, 1918, it was announced from headquarters that $34,282.91 had been pledged.

As a special Christmas activity, Nela Fund encouraged the sending of gifts to orphans and godsons. Due to the shipping space required for ordnance and military supplies, it was suggested that money, rather than packages, be given. Such a request was also made in 1918 and 1919.

Below is listed the number of persons who were being cared for in the years 1917 and 1918—the big increases in 1918 being largely due to the 1917 Christmas Drive.

	1917	*1918*
Orphans	72	414
Widows		2
Godsons	37	83
Total	109	499

In addition to the sums forwarded to orphans, widows and soldier-godsons, contributions were also made through Nela Fund to the American Service Fund, Paris; Mr. Tremaine's "Sock League" and to miscellaneous activities, such as the Association for Supplying Games to Soldiers, and packages for soldiers.

A portion of the amount raised in 1918 was subscribed after the close of the Christmas Drive, for members of Nela were at all times on the search for buyers of this wartime "investment." During 1918, a total of 236 new subscriptions were accepted.

The following letters from French children are typical of those received by godparents. The first was written by a girl of eleven years, the orphan of a French officer and eldest of nine children:

> "I know a little English and can write well enough in that language to thank you for the big sum you sent to mother for us.
>
> "My little sister, who is ill, can now have help and I do thank you with all my heart for that joy."

Her brother, a boy of nine years, expressed his appreciation in these words:

> "With all my heart, thanks! for the money you have sent to us. I should like to be as kind as the Americans who help the French so much, and I should also like to be an officer so as to be able to go to war with them. Long live our Allies!"

Finally, a third youth of the family, a boy of eight, wrote:

> "I thank you in the name of my little brother and sisters for the generous gift which Mamma received. When I am grown up, I shall go to Nela Park to see you."

At the 1918 summer conference at Association Island, Nela Fund was again a prominent topic of conversation and, following the generous example set at the 1917 meeting, the National managers once more contributed liberally to its support. The sum of $1540 was raised as a contribution towards the expenses of the Fund. It was decided to conduct a Christmas Drive along lines similar to those on which the 1917 campaign was run and, besides securing new pledges, to make sure that old subscriptions were renewed.

1918 CHRISTMAS DRIVE

NOVEMBER 28 TO DECEMBER 24

In a letter under date of December 5th, 1918, Mr. Terry emphasized that we in America could ill afford to desert the French people at this time, for the sacrifices which they made for us, as well as for themselves, had dug deeply into the roots of their existence. This was sufficient justification for renewing once more the efforts of 1917. A general letter of January 23rd, 1919, contained the thought that though the Nela Fund was no longer a "winning the war" activity, yet the conditions and needs of the French were such they could not become self-supporting for some time. Until that day was at hand it was our duty, as well as our privilege, to contribute to the limit of our means for the support and education of the children upon whom rested the regeneration of France's industrial and economic life.

The organization of the 1918 Drive was practically the same as that of 1917. Each Nela member was asked to be responsible for $200 in subscriptions in addition to securing a renewal of his 1917 pledges. Members, as before, conducted their own campaigns for funds, working diligently to meet their quotas. Due to the fighting being over, it was found difficult to interest new prospects, but old subscribers were readily re-signed. They had become confirmed supporters of the work and many of them were influential in securing new subscriptions.

In the 1918 Drive, new subscriptions totalling $14,766.15 were received, besides the renewal of a majority of the 1917 pledges. The entire sum raised was appropriated for the care of orphans and widows, the soldier-godson movement ending with December 31st. The special Christmas offering amounted to $518 which was distributed among 66 orphans, 5 godsons and one widow.

NELA FUND AFTER THE WAR

Nela Fund "carried on" after war ceased. It was decided that so long as a distressing need existed among French families it would be unwise to discontinue the efforts which had meant so much to them during the war. Further, a majority of those who had "adopted" orphans had become so interested in their proteges that they had no desire to cancel their attentions at this time, or in the very near future.

In the spring of 1919 Mr. Terry went abroad and visited personally many of the orphans "adopted" through the Nela Fund. This trip was of value both in reviewing the field which Nela Fund had covered during the war and as a canvass of the needs which still existed in France for interested relief work. As the need was still found to be urgent, a third Christmas Drive was held in 1919.

PART IV

MOBILIZING OUR DOLLARS

The National Lamp Works'
Financial Record in Connection
With the World War

MOBILIZING OUR DOLLARS

THE NATIONAL LAMP WORKS' FINANCIAL RECORD IN CONNECTION WITH THE WORLD WAR

"Everyone should invest what he can reasonably afford to in Liberty Loan Bonds. *We should do this even if we can invest our money in something else with a higher rate of return.*"

The foregoing quotation from Terry and Tremaine's General Letter of May 24th, 1917, written just after the First Liberty Loan campaign was announced, is indicative of the attitude taken by the National towards the many money-raising campaigns conducted by the Government throughout the war—except that, as the war progressed, the appeals of the management for whole-hearted support, even if such support should involve real financial sacrifice to the contributor, became more and more urgent. This fact will be evident from the quotations given further on in this chapter, from General Letters issued on the occasions of the Second, Third and Fourth Liberty Loans.

The employees of the National Lamp organization responded nobly to every Government appeal for funds, as is abundantly proven by the huge financial totals given below. National people would have responded nobly, beyond a doubt, even without the encouragement and assistance that they received from their leaders. At the same time, it is obvious that the totals would have been very much less, had it not been for the organizing genius that was focused on getting everyone to do his or her part, and on creating a spirit of rivalry among the different Divisions of the organization—each striving to outdo the others in the outpouring of its money for America and world freedom.

Figures—to many people at least—are cold, lifeless things, and statistics are certainly not "light summer reading." But figures become endued with life and interest when they pertain to a war, for the winning of a war, when all is said and done, is largely a matter of which side can raise the more money.

War is always a strain on the financial resources of a country—but in a life-and-death conflict like the World War of 1914–1918 it is more than an ordinary strain—it becomes an appalling financial drain.

How the National and its people mobilized their dollars in addition to their personal work and material resources, will be told in the present chapter. The subject will be taken up under the following headings:

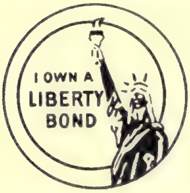
I. The Liberty Loans—First, Second, Third and Fourth.
II. War Savings Stamps.
III. The Red Cross Campaigns.
IV. The Y. M. C. A. Campaign.
V. Miscellaneous Nation-Wide Relief Campaigns.
VI. War Chests.
VII. United War Work Campaign.
VIII. Nela Fund, for French War Orphans, Widows and Soldiers.
IX. "Children of the Frontier."
X. "Socks for Soldiers."
XI. Financial Aspect of Red Cross Workers' Activity.
XII. Financial Support of War Gardening.
XIII. Support of War Activities (Research and Development) Undertaken by Home Office Laboratories.
XIV. Miscellaneous Financial Contributions towards Winning the War.
XV. Summary.

I. THE LIBERTY LOANS

THE FIRST LIBERTY LOAN

June 1 to 15, 1917

The first great popular bond issue floated by the United States Government was for the sum of two billion dollars, and was known as the First Liberty Loan. It was the first time that United States Gold Bonds were ever offered to the public in such small denomination as fifty dollars—the "baby bonds," so called. Also, it was the first time that Uncle Sam had ever resorted to a whirlwind campaign of advertising and salesmanship in order to market his securities.



As we look back on the First Loan, remembering that before the war was over our Government raised a total of between twenty and thirty billion dollars by the sale of Liberty Bonds and War Savings Stamps, it seems almost amusing to consider the serious doubts that were entertained by many people as to whether we could raise even two billion dollars in one campaign.

Suffice it to say that instead of two billion dollars, nearly three billion dollars were subscribed to the First Liberty Loan. As over-subscriptions were not accepted, there were many large investors who were disappointed in that their subscriptions were not taken.

The First Liberty Loan Bonds, as originally issued, bore interest at the rate of 3½%, and were tax-free except for inheritance taxes. The bonds mature in 1947. The bond-selling campaign lasted from June 1 to 15, 1917.

The following quotations are from a General Letter dated May 29, 1917, and sent by the Managers of the National Lamp Works to all Departments and Divisions:

"The General Electric Company is taking an interest in inducing its employees to purchase these bonds and will assist them in financing their purchase where necessary. The General Electric Company has, for its own account, agreed to purchase $5,000,000 of these bonds.

"We would like to make the General Electric subscription as large as possible, and would request, therefore, that subscriptions be turned in through Mr. See, who, in turn, will report the amount to the General Electric Company, Schenectady, to be included with the subscriptions from the employees of the other branches of the G. E. Company.

"June 6th has been made the day on which a canvass will be made in all departments."

The various departments took up the appointed task energetically, with the following results:

First Liberty Loan

Number of Individual Subscribers	3389
Amount Subscribed	$278,200

The Company's Liberty Loan "machinery" was not as thoroughly organized for this first bond issue as it was later. In consequence, many individuals subscribed through local banks rather than through the company. Such subscriptions are not included in the above total. On the other hand, many employees persuaded their friends, outside of the National, to subscribe through them, so that on the whole the foregoing total may be considered a fairly accurate representation of the amount actually invested by the National employees.

A word should be said in recognition of the extensive and often burdensome work so faithfully performed by the employees of the Treasury Department, the greatest war activity of which during 1917 and 1918 was in connection with the Liberty Loans—assembling subscriptions and placing with banks, crediting collections from month to month, and delivering bonds to subscribers as paid for. Approximately seven thousand dollars in expenses were incurred by the Treasury Department in handling the four Liberty Loans.

Employees were given their choice of five different plans for making payments:

(a) the weekly plan (2% per week for 50 weeks);
(b) the semi-monthly plan (each payment 5% of the amount subscribed);
(c) the monthly plan (each payment 10%);
(d) the Government terms;
(e) one payment in cash.

Plans (a), (b), and (c) were much more liberal than the Government terms, and gave the subscriber practically ten months in which to pay. Under these "easy-payment" plans, the company advanced the money to the Government, through the banks, and carried the individuals' accounts until they were paid up.

The ten-month schedule of payment applied to the First, Second and Third Loans only. When the Fourth Loan came along, the time for payment had to be reduced to five months, as it began to look as if we might expect new Liberty Loans regularly, at about five-month intervals.

On June 12th Miss Ruth Law, then the foremost aviatrix, made an exhibition flight over Cleveland under the auspices of Henry L. Doherty & Co.

Miss Law "took off" from Nela Park and on her flight dropped "bombs" advertising the Loan.

THE SECOND LIBERTY LOAN

October 21 to 26, 1917

In the fall of 1917, "we, the people," were called upon to loan three billion dollars more to our Government. The Second Liberty Loan, bearing interest at the rate of 4%, maturing in 1942, and taxable only for inheritance taxes and for surtaxes above a certain exemption, went "over the top" in a whirlwind campaign of only one week. It was over-subscribed by $1,617,532,300, but only half of this over-subscription was accepted by the Government.

GET BEHIND
LIBERTY LOAN
OF
1917
THE GOVERNMENT

The following extracts from General Letters issued by the National management just prior to the Second Loan campaign are of interest:

"*Keeping Bonds for Employees:* Many buyers of Liberty Loan Bonds have never before handled bonds and have no safe place in which to keep them and will not understand how to handle the interest coupons. Where desired, we will hold the bonds and look out for these matters for such employees. The bonds left with us for safe keeping will be held in the safety deposit vault of the Cleveland Trust Company, and upon request will be forwarded for delivery to the individual."

"*Liberty Loan Number 2:* We are again called upon for action — we can call it patriotism if we like — the Second Liberty Loan. We do not ourselves term it patriotism because our motive is more than our love of country; it is to maintain our freedom that we are making sacrifices and our soldiers are fighting. It is that we may have what we believe to be our inalienable right to live in peace and without the necessity of being skilled in the most scientific means of destroying others. We wish our progress to be the result of constructive work and helpfulness to others and not the destruction of others or their subjugation.

"It is too late for us to discuss the question of whether we will fight or take the chance of being subjugated. That question has already been decided for us, and we know that whatever it may cost in lives and money to win, a greater loss will be ours if we fail to win. The situation is too critical for one to consider that his part is less than all that he can do. There is little danger of our being required to make sacrifices as great as those which the people of Belgium, France and England have been called upon to make, and yet, in this common cause, it would be but just if as much were required of us.

'We hope to have reason, again, for feeling proud of our organization because of the way our employees respond to this second call for funds with which to carry on this most just and necessary fight for liberty."

The total subscriptions through the National Lamp Works were as follows:

Second Liberty Loan

Number of Individual Subscribers	2961
Amount Subscribed	$250,400

Voluntary Solicitation by National Employees

No attempt has been, or can be, made to compute the total amount of time put in by men and women of the National in house-to-house canvassing and other "yeoman service" in connection with the various war-financing campaigns. Some of this work was done Saturday afternoons and evenings, but much of it was done on the Company's time—a service which was not only permitted, but freely encouraged by the management.

Just as an instance: Eleven men in the Nela Specialties and Commercial Development Departments put in 1609 hours—the equivalent of 214 working days, on work of this kind.

Several of the managers were members of City or County Sales Committees for the various loans, and made public appeals for subscriptions or acted as chairman at meetings where such appeals were made.

The manager of the Nela Operating Department assisted in the four Liberty Loans by conveying Liberty Loan speakers to their assigned localities for speeches.

THE THIRD LIBERTY LOAN

April 6 to May 14, 1918

The Third Loan came at a crucial point in the war—a time when the allies were being pressed back by the Central Powers' Spring Drive on the Western Front. The size of the loan, $3,000,000,000—which was nearly 40% oversubscribed—was in proportion to the need. This loan bore interest at 4¼%, matured in 1928, and was tax-free with the same general class of exceptions as noted under the Second Loan, above. The pressing importance of the Third Loan was clearly brought out in the letter sent out by the National management on March 29:

THIRD
LIBERTY LOAN

"The Third Liberty Loan Drive starts April 6th.

"We shall count on the National organization doing its full part, as usual.

"It does not make any difference how much we have done or how difficult it is to do more, each one of us must do his

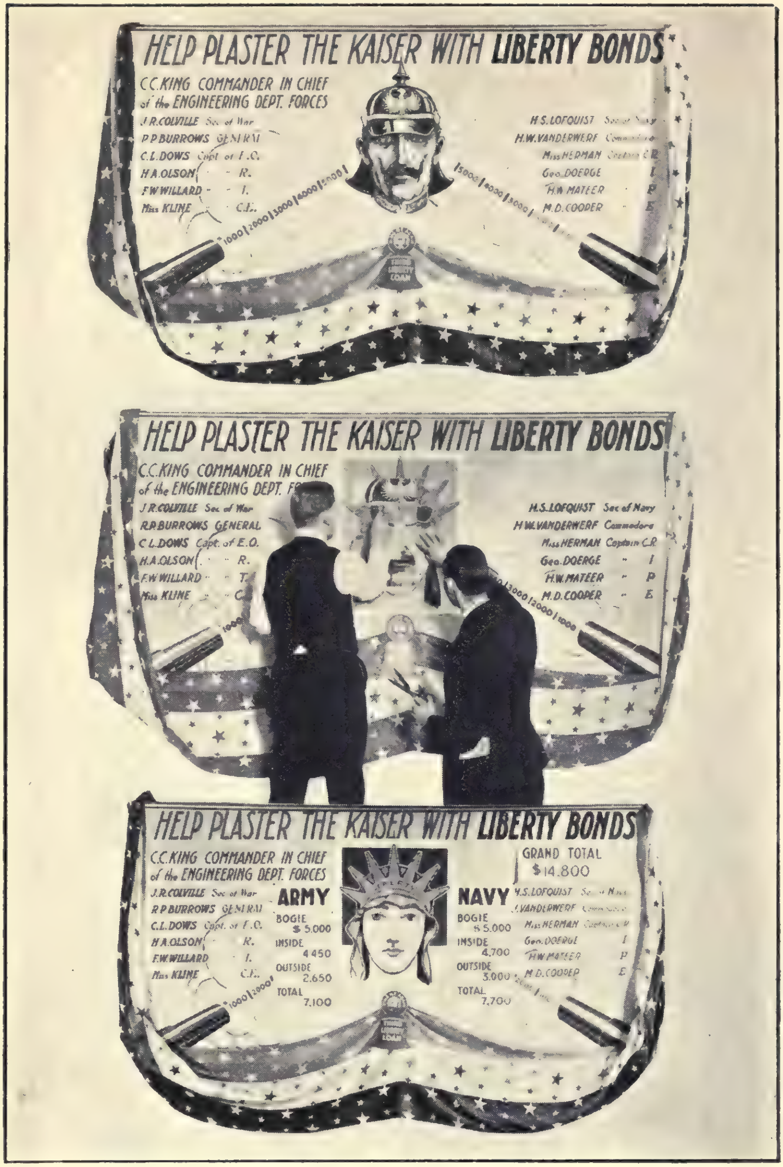
3rd LIBERTY LOAI
45th ST
NELA
52nd ST.
VERYBODY IN
PN 104

3rd Liberty Loan Rally at Nela, April 11, 1918

Left—Mr. L. P. Sawyer, Chairman.
Center—Lieut. MacGregor McIntosh, Speaker.
Right—Mr. Homer H. McKeehan, Speaker.

LIBERTY LOAN DRIVE

The "Race to Berlin"—A Bond-Raising Stimulus Used by the Engineering Department


HELP PLASTER THE KAISER WITH LIBERTY BONDS
C.C. KING COMMANDER IN CHIEF
of the ENGINEERING DEPT. FORCES
J.R. COLVILLE Sec. of War
P.P. BURROWS GENERAL
C.L. DOWS Capt. of E.O.
H.A. OLSON R.
F.W. WILLARD T.
Miss KLINE C.E.
H.S. LOFQUIST Sec. of Navy
H.W. VANDERWERF Commodore
Miss HERMAN Captain C.R.
Geo. DOERGE I
H.W. MATEER P
M.D. COOPER E
1000 2000 3000 4000 5000
THIRD LIBERTY LOAN
GRAND TOTAL
$14.800
ARMY
BOGIE $5.000
INSIDE 4450
OUTSIDE 2.650
TOTAL 7.100
NAVY
BOGIE $5.000
INSIDE 4.700
OUTSIDE 3.000
TOTAL 7.700
LIBERTY

"Plastering the Kaiser with Liberty Bonds"

A Campaign Progress Chart used by the Engineering Department in the Third Loan Campaign part, and undoubtedly in addition to this demand there will be many more before the war comes to an end.

"No one has the right to complain unless he is required to do more than the young man who is drafted and compelled to give up his position and prospects here and live the trench life of a soldier, and risk his life and health in addition.

"The French people have been required to make real sacrifices. All that we have so far been asked to do is to practice a little self-denial.

"If the Germans should win, we need not continue valuing either our lives or our property. We are better off to give up everything, including our lives, than to have them win.

"Everyone's part is all that he can do, nothing less. Not many of us will do our full part.

"The plan of taking subscriptions, and forms, will be sent out later."

The Third Loan subscriptions placed through the National Lamp Works totalled as follows:

Third Liberty Loan

Number of Individual Subscribers	6196
Amount Subscribed	$446,800

How Enthusiasm Was Aroused

Much of the success of the several Liberty Loan campaigns, so far as the National was concerned, was due to the rivalry fostered among the different Departments and Divisions by the Publicity Department, under the direction of Mr. N. H. Boynton. In fact, war work campaigns were made the principal business of this Department up to the time that the armistice was signed.

During the Loan campaigns, a vigorous follow-up campaign was conducted both by mail and by telegraph to the various Divisions, all of which were placed on a quota basis. Speakers were secured to address meetings of the employees. Some of these speakers were from outside of the National organization; others, such as J. M. Smith and "Billy" Evans, were from the organization itself.

Lively three-cornered contests were staged among the three Cleveland properties—Nela Park, East 45th St., and East 152nd St. Large charts posted in each of the three cafeterias were used to post the comparative showings from day to day, and thus stimulate rivalry. Special charts in the Nela cafeteria showed the relative progress of the various departments at Nela Park in securing subscriptions to the Loans.

During the Second and Third Loan Campaigns, respectively, two novel methods were used by the Engineering Department to stimulate greater subscriptions within its ranks. A "Race to Berlin"—across the Atlantic Ocean—was represented by a large painting near the Department entrance during the Second Loan Campaign, two Engineering Department teams competing to see which would "reach Berlin first," by securing more subscriptions than the other. For the Third Loan Campaign, this painting was replaced by one representing the Kaiser's face (see illustrations), the game being to "Plaster the Kaiser's face with Liberty Bonds," thereby transforming it into a picture of the Goddess of Liberty.

THE FOURTH LIBERTY LOAN

September 28 to October 19, 1918

"Let's finish the job" was the appeal that won subscriptions to the fourth and final loan floated by the Government before the Central Powers surrendered. The "Huns" were already on the retreat; casualty lists were pouring in every day, telling the number of American boys killed and wounded; and it is therefore not strange that the outpouring of funds came from a greater number of individual subscribers than for any previous loan.

FOURTH
LIBERTY LOAN

The bond offering was for $6,000,000,000 at 4¼%, with all oversubscriptions accepted. Practically $7,000,000,000 was actually subscribed. The loan matured in 1938, and was subject to the same general tax conditions as noted under the Second Loan above.

Terry and Tremaine's General Letter of September 25th sounded the keynote:

"We know that the National organization will do its best, as before. It is unnecessary to reiterate the reasons why each one of us must do his part.

"Just now, when everything seems to be coming our way, there is a greater necessity for our helping to pull the load to the last ounce of our strength. Everything that we do in the right direction will have its influence in bringing the war to an early end."

The National rolled up a total more than 40% greater than for any preceding loan, as shown by the following:

Fourth Liberty Loan

Number of Individual Subscriptions	7270
Amount Subscribed	$760,850

THE VICTORY LOAN

April 21 to May 3, 1919

The last of the Liberty Loans came several months after the armistice was signed. The slogan was "Bring the Boys Back Home." We include mention of the Fifth Liberty Loan merely for the sake of completeness, as it was not a "war activity" strictly speaking, and the National kept no consolidated record of its employees' subscriptions, handsome as the total undoubtedly was.

Many of the lamp people put in just as long hours working for the Victory Loan as they had for the previous offerings, and their efforts helped in putting the campaign "over the top." Just as one instance we cite the work of Mr. Geary, Manager of the Fostoria Incandescent Lamp Division. Let him tell his own story:

"The quota for the City of Fostoria was $292,000, and I had an inspiration to secure pledges for $100,000 of this personally, without letting anyone know except the subscribers; then, when the campaign workers were within $100,000 of their goal, let the cat out of the bag and break up their party.

"I succeeded in getting 23 subscriptions of $5000 each, in about thirty-six hours, and could not work on this any longer because I was Chairman of the Committee to secure subscriptions from all of the manufacturing plants in Fostoria, and it would have looked as though I was neglecting the latter job. Otherwise, I could probably have sold about half a dozen more $5000 subscriptions.

"On the third night of the campaign, a big rally was held with a band, speakers, etc., and since the workers were strenuously pressing those who had given me their subscriptions, I decided not to keep my secret any longer, as it would add enthusiasm to the campaign if I announced the twenty-three $5000 subscriptions then and there. This was done.

"As there was only $20,000 left to be subscribed after the rally, the next morning Fostoria went over the top."

II. WAR SAVINGS STAMPS

I
HAVE
PLEDGED
W.S.S.

In order to encourage systematic saving of money for war purposes, and to make it possible for everyone to loan to the Government the small sums that are so easily wasted on trifles, the War Savings Stamp plan was put into effect by the U. S. Treasury Department, commencing as of January 1, 1918.

"Thrift Stamps" were sold at 25 cents each, and were pasted on to "Thrift Cards" holding sixteen stamps ($4 worth). Each Thrift Card, when full, was exchangeable for a "War Savings Stamp" (upon payment of an additional amount varying from 12 cents to 24 cents, depending upon the month in which the exchange was made). These War Savings Stamps—"W. S. S.," they were commonly called—costing the purchaser from $4.12 to $4.24, attained in five years a maturity value of $5.00 cash — equivalent to 4.27% interest on the money invested.

Throughout the National Lamp Works, the stamps were placed on sale by the Cashiers of all Divisions and Departments, as well as by the Savings and Investment Section at Nela Park. At the same time all aggressive efforts at selling "Nela Alpha" Savings Stamps were suspended, so that employees would not be deterred from putting their savings into W. S. S.

The National Lamp Works went a step further. It instituted a plan whereby employees of more than five years' standing, who were receiving a semiannual bonus of 5% on their earnings, were urged to accept this bonus in the form of War Savings Stamps rather than cash. A General Letter dated Jan. 10, 1918, relates to this subject:

> "*Paying Supplementary Compensation in War Savings Stamps*
>
> "It is highly important that all managers of departments and others encourage the sale of War Savings Stamps wherever and whenever possible....... One definite means of encouraging the sale of War Savings Stamps is to secure the consent of our employees who are entitled to the Supplementary Compensation, December 31, 1917.
>
> "Please discuss this matter with each employee. You will probably be successful in disposing of a large number of these stamps and certificates.
>
> "An effort should be made to have the entire bonus paid in certificates or stamps.
>
> TERRY AND TREMAINE
> Managers"

Mr. J. Robert Crouse, former Manager of Sales of the National Lamp Works, was appointed Director of Sales for the Cuyahoga War Savings Committee. He suspended all of his personal business activities in order to give his entire time to this formidable patriotic task, which was rendered all the more difficult by the fact that the War Savings Drives had to be subordinated to the Liberty Loan Drives whenever the latter were in progress. The Cuyahoga County quota of W. S S. for 1918 was $16,000,000. The services of the National were placed at Mr. Crouse's disposal, and were helpful to him in many instances during the campaign. The employees of the National in Cleveland subscribed a total of $90,597 in War Savings Stamps.

At the Summer Meeting of the National Managers at Association Island, in 1918, individual W. S. S. pledges aggregating several thousand dollars were secured by Mr. Crouse from the managers.

It is interesting to note that Cuyahoga County attained 91 per cent of its W. S. S. quota—a higher percentage than was reached by any other of the counties in which the ten largest cities of the United States were located. Cleveland also ranked highest in *per capita* sales.

Total National Lamp Works W.. S. S. Sales (1918)

Since the War Savings Stamps were on sale through so many different agencies—postoffices, retail stores, Boy

Scouts, school children, etc.—it is impossible to compile a complete total of purchases by National Lamp people. The following minimum figures, however, are at hand, and are impressive even in their incompleteness.

Number of War Savings Stamp Buyers....	5445
Amount Purchased (at Purchase Value)....	$141,260

The St. Louis Mazda employees subscribed $42.45 to the John Ring, Jr. State Statue Fund—a fund for the erection of a mammoth statue with booth for the sale of Thrift Stamps and W. S. S., on Twelfth Street, St. Louis.

SUMMARY

GOVERNMENT SECURITIES PURCHASED THROUGH NATIONAL LAMP WORKS DURING THE WAR

Liberty Loan No. 1	$ 278,200
Liberty Loan No. 2	250,400
Liberty Loan No. 3	446,800
Liberty Loan No. 4	760,850
Liberty Loan, Total	$1,736,250
War Savings Stamps	$ 141,260
GRAND TOTAL	$1,877,510

III. THE RED CROSS CAMPAIGNS

In June, 1917, the American Red Cross conducted a nation-wide drive to raise $100,000,000 with which to carry on its work of caring for the sick and wounded, its canteens at the various camps and railroad stations, and so forth. In December of the same year there was a big Red Cross Membership Campaign for the purpose of enrolling millions of new members in the Red Cross at one dollar each, and for securing subscriptions to the Red Cross Magazine.

In the year 1918 campaigns of the Red Cross were merged with the campaigns of six other large war-relief organizations, the combined drive being known as the "United War Work Campaign." In Cleveland and many other cities the funds were raised in 1918 through the medium of the city's "Community War Chest." The only "independent" campaigns of the Red Cross, therefore, were in 1917 and it is these that are referred to below.

THE FIRST RED CROSS DRIVE

June 18 to 25, 1917

A canvass of the National managers, resulting in pledges for several thousand dollars, was made *en route* to the managers' summer meeting at Association Island.

The record made by the National Lamp Works in this campaign was as follows:

Amount Pledged	$17,618.82
Number of Givers	Over 5100
Number of Givers in Cleveland Departments	3240

$11,033.60 of the amount donated to the Red Cross was subscribed through, and paid over by, the National Lamp Works' Treasury Department, Cleveland.

Mr. F. S. Terry was Captain of Team 26, appointed to secure Red Cross subscriptions from business men and others in the Cleveland district. This team reported $213,874.59, from 20,662 subscribers. The flag for the largest number of subscribers of any of the 50 competing teams was awarded to Mr. Terry.

1917 RED CROSS MEMBERSHIP CAMPAIGN

December 17 to 24, 1917

The campaign to secure Red Cross memberships, and subscriptions to the Red Cross Magazine, was generally conducted by the local Red Cross Chapters in a house-to-house canvass without official solicitation. It is estimated that the total number of dollar memberships taken out by National employees was approximately 6,000.

The National Service Department canvassed the Cleveland Divisions and obtained 2,552 memberships—897 from Nela Park and 1655 from the other local Divisions.

For the Red Cross Membership Campaign, Mr. N. H. Boynton directed the Advertising and Sales Promotion activities in the "Lake Division," consisting of Ohio, Indiana and Kentucky. In this work he was one of the principal aides of Mr. James R. Garfield, Director of the Lake Division. Under Mr. Boynton's supervision 464 full-page advertisements were financed in the newspapers of the three states. The Lake Division ranked first among all the Divisions in total number of members secured (2,300,000), and it greatly exceeded all other Divisions in percentage of quota realized.

IV. THE Y. M. C. A. CAMPAIGN

November 12 to 17, 1917

Greater efforts were made by the Government to build up the morale and look after the general well-being of its troops in the World War than in any previous conflict. One of the first organizations called upon for this service was the Young Men's Christian Association, owing to the fact that it was thoroughly organized on a national scale for the purpose of ministering to the needs of young men, and could readily throw its machinery over to war purposes. The "Y Hut" soon became a feature of every U. S. military camp, and the activities even extended to the armies of our allies.

I Have Subscribed
Y.M.C.A.
WAR
WORK

The 1917 Y. M. C. A. campaign had for its object the raising of $35,000,000 to carry on the "Y" work here and abroad. The campaign was non-partisan, being supported by Jews, Catholics and Protestants, as well as by men of no religious profession.

As in all the other war-work campaigns, an untold amount of volunteer canvassing was done by individuals in the National Lamp organization. Mr. N. H. Boynton directed the advertising of the campaign in Northern Ohio, including Cuyahoga County, besides serving on a team captained by Mr. J. Robert Crouse.

Fifty of the 76 Divisions and Departments of the National turned in reports showing the amounts donated by their employees in the Y. M. C. A. drive. It is estimated that 100% of the Divisions participated, although only 50 kept a permanent record of the amount given. The total from the reporting Divisions was as follows:

Number of Individual Donations	3284
Amount Donated	$8068

V. MISCELLANEOUS NATION-WIDE RELIEF CAMPAIGNS

As the war proceeded, the various clearing-houses for war relief, such as the city War Chests, became better organized and there were consequently fewer organizations, perhaps, appealing directly to the citizens for funds in 1918 than in 1917.

In 1917 the relief organizations had not fully realized the tremendous saving in expense and effort that could be secured by *pooling* their "sales" efforts.

An attempt was made to secure figures from the various branches of the National as to the amounts donated by their people to miscellaneous war-relief agencies, but the information secured is only fragmentary, as might be expected in view of the fact that no official records of such campaigns were kept by the Company. The reader is therefore at liberty to multiply the following figures by any factor which he may think necessary to make them include the entire National:

MISCELLANEOUS CONTRIBUTIONS REPORTED

Nature of Contribution	*No. of Divisions Reporting*	*No. of persons Contributing*	*Amounts*
Knights of Columbus	7	216	$425.00
"Smileage" (A nation-wide fund for providing movies and other clean entertainment for soldiers in camp)	2	188	415.00
Armenian, Belgian and Syrian Relief	2	650	190.75
Salvation Army	1	...	100.00
Jewish Relief	1	8	4.10
Cleveland War Industries Committee	Home Office	...	250.00
Trumbull County Finance Association	Home Office	...	375.00
Detroit Patriotic Fund	Home Office	...	350.00
Navy League of Canada	Home Office	...	500.00
Cleveland Naval Auxiliary Bank	Home Office	...	50.00
American Allies Co-operative Committee	Home Office	...	5.00
Christmas Boxes for Soldiers	Home Office	...	430.00
Salvation Army	Home Office	...	100.00
Not Specified	3	17	664.00
Total			$3,858.85

VI. WAR CHESTS

In 1918 hundreds of city and county "War Chests" sprang up spontaneously over a large portion of the United States. Their purpose was to protect the contributing public from constant miscellaneous appeals—particularly irresponsible and questionable appeals—and to *stimulate* giving by assigning "grateful quotas" to the citizens according to their ability to pay, and urging them to "give only once, but give enough for a whole year." The War Chests had the added advantage of being able to finance and collect contributions on the "installment plan." Committees of representative citizens handled the funds and decided what percentage should be given to the various War Relief agencies, such as the Red Cross, Y. M. C. A., Salvation Army, etc., etc. In order to make wise selections of the relief work to be supported, several of the War Chests formed an association, known as the "National Investigation Bureau," with headquarters in New York.

The following list shows in what cities War Chest campaigns were conducted, considering only those places in which the National Lamp Works had Divisions or Departments:

Cleveland	"Victory Chest" (Campaign May 20-27, 1918).
Minneapolis	"War Chest of Minneapolis and Hennepin County" (Campaign Dec. 2-7, 1918).
Shelby	"Richland County War Chest."
Niles	"Trumbull County War Chest."
Warren	"Trumbull County War Chest."
Youngstown	"Mahoning County War Chest."
Fostoria	"Fostoria War Chest."

The National management heartily endorsed the War Chest idea, as is proven by the following extract from a General Letter by Mr. F. S. Terry, dated November 9, 1919:

"We believe in war chests as the most economical and efficient way of handling funds for war relief work. This relief work should not be considered a charity, for what one will do for charity is a matter for individual decision. It is more like taxes, but each one is under even more obligation to do his part. We are interested in what others do, for what they neglect to do must be done by us or by someone else. Separate campaigns for the different war relief activities not only duplicate work and expense and are uneconomical, but they make it more difficult for each one of us to determine his fair proportion. The war chest is a protection to all contributors. Our experience in Cleveland fully justifies our belief in this method of handling funds for war relief activities."

CLEVELAND "VICTORY CHEST" CAMPAIGN

May 20 to 27, 1918

Six million dollars was the goal aimed for in the Cleveland campaign. It was an overwhelming success, approximately eleven million dollars being actually subscribed.

Business Men's Team No. 16 was captained by Mr. F. S. Terry, and reported $328,578.61. Many of the National Lamp Works managers in Cleveland turned in their personal subscriptions through Mr. Terry's team.

Mr. N. H. Boynton acted as Advertising Manager of the Cleveland campaign.

The employees of the various industrial plants, including the Cleveland branches of the National, were asked to give to the fund half-a-day's pay per month for seven months. The total subscription of the National Lamp Works, including that of the employees in the 46 Cleveland departments, amounted to $157,542.30, nearly 4000 employees taking part. $30,892.59 of this amount, taken on the installment plan, was paid through the Treasury Department at Nela Park, to Mr. Myron T. Herrick, Treasurer of the Cleveland War Council.

MINNEAPOLIS WAR CHEST CAMPAIGN

December 2 to 7, 1918

419 employees of the Minnesota Mazda Lamp Division subscribed $4152.36.

RICHLAND COUNTY WAR CHEST OF 1918

Eight employees of the Shelby Lamp (Sales) Division subscribed $1066.00.

TRUMBULL COUNTY WAR CHEST OF 1918

Division	*No. of Subscribers*	*Amt. Subscribed*
Mahoning Miniature	238	$ 2,094.00
Trumbull Mazda	195	1,475.50
Ohio Division	516	4,050.00
Peerless (Sales)	18	1,900.00

TRUMBULL COUNTY WAR CHEST—Continued

Division	*No. of Subscribers*	*Amt. Subscribed*
Colonial (Sales)	7	108.00
Packard (Sales)	9	285.00
Sterling (Sales)	22	803.00
Niles Glass	367	4,566.04
Home Office	...	10,000.00
Totals	1372	$24,281.54

FOSTORIA WAR CHEST OF 1918

Division	*No. of Subscribers*	*Amt. Subscribed*
Fostoria (Sales) (including a company subscription)	22	$1,355.39
Loudon Glass (including a company subscription)	215	2,810.47
Totals	237	$4,165.86

MAHONING COUNTY WAR CHEST OF 1918

Division	*No. of Subscribers*	*Amt. Subscribed*
Youngstown Mazda (including a company subscription	506	$4,792.50
Banner (Sales) (including a company subscription)	12	1,259.00
Totals	518	$6,051.50

GRAND TOTAL, ALL WAR CHESTS

Place	*Amt. Subscribed*
Cleveland	$157,542.30
Minneapolis	4,152.36
Richland County	1,066.00
Trumbull County	24,281.54
Mahoning County	6,051.50
Fostoria	4,165.86
GRAND TOTAL	$197,259.56

The vast amount of volunteer canvassing done by National employees in the various money-raising drives has already been mentioned, and the War Chests were no exception. As an instance of these efforts, may be mentioned the spectacular result achieved by Mr. H. H. Geary, Manager of the Fostoria Incandescent Lamp Division, who had charge of the War

Chest solicitation among the factory workers in the city of Fostoria. He succeeded in getting pledges from every industrial worker in the city, except two—both of them old men above seventy, from whom he considered it an imposition to demand subscriptions. Later, however, the local Committee got even these two to pledge five cents per week, just for the sake of making Fostoria a "One Hundred Percent City."

VII. UNITED WAR WORK CAMPAIGN

November 11 to 18, 1918

National Lamp Works people in the following cities, where there were no War Chests, were called upon to subscribe to the $170,500,000 War Work Fund:

FOR THE
BOYS
OVER
THERE
UNITED WAR WORK CAMPAIGN

St. Louis
Central Falls
Oakland
Detroit
Chicago
Providence
New York

Seven great co-operating war-work agencies, each of them operating under an Executive Order from President Wilson, participated in the drive. These were the organizations:

Young Men's Christian Association
Young Women's Christian Association
National Catholic War Council (K. of C.)
Jewish Welfare Board
War Camp Community Service
American Library Association
Salvation Army

The long arm of these great agencies extended all the way from the 500 clubs operated by the War Camp Community Service "over here," to the front line trenches where the Y. M. C. A. and Knights of Columbus and Jewish Welfare Board distributed chocolate and cigarettes to the tired fighters, and where the Salvation Army passed out pies and doughnuts, did sewing and mending for the fighters, and manned ambulances. Through the American Library Association, it furnished books. It reached into the factories, through the Y. W. C. A., to protect the girls who made equipment for our troops, and into the shipyards and munition plants.

The fact that the armistice was signed on the very opening day of the United War Work campaign, did not prevent the National Divisions in the above-mentioned cities from giving abundantly to the fund, as these figures will indicate:

Total number of employees subscribing (*approx.*)	2100
Total amount of subscriptions reported	$17,463.65
Largest number of employees subscribing from any one Division (Oakland)	425
Largest amount subscribed by employees of any one Division (St. Louis)	$2,895

VIII. NELA FUND, FOR FRENCH WAR ORPHANS, WIDOWS AND SOLDIERS

The story of Nela Fund has been told in Part III. To one who is aware of the manifold comforts which came to orphaned children, burdened mothers and suffering French soldiers through the kindness of Nela Fund subscribers, the statistics set forth below cannot be read with any feeling other than of pride and satisfaction. This is especially true because every dollar subscribed by an individual was applied in the maintenance of an orphan or godson of his own choice, with whom he had the expressed privilege of communicating directly, or through channels provided by Nela Fund.

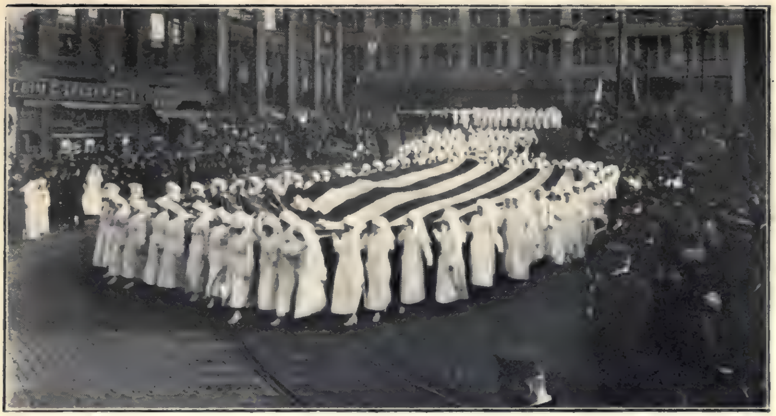
This accounts in large part for the liberal support accorded the Fund in the "Christmas Drives" of 1917 and 1918. Mr. N. H. Boynton, when asked by Mr. Terry to conduct the 1918 Christmas Drive, answered him, in part: "No campaign plan is necessary, other than your suggestion that we all apply ourselves to the work and accomplish it in the shortest possible time." His words expressed the sentiment of every member of Nela and of all others who were interested in securing funds for this personal-interest work. Below are the salient figures for the years 1917 and 1918.

YEAR 1917

259 subscriptions raised in 1917-18 Christmas drive (Part of these came in in January and February, 1918)	$34,282.91
213 total subscriptions secured up to Dec. 31, 1917	16,922.50

These subscriptions were distributed as follows:

About 48% were for soldier-godsons.
About 52% were for orphans.



National Lamp Girls Collected $1,700 for the Victory Chest in this Flag.
Scene: Public Square, Cleveland

A Noon Meeting at "Ivanhoe" during the Red Cross Campaign of 1917.

French Refugee Children, cared for by the "Society for Protecting Children of the Frontier." The girls in the upper picture are weaving baskets. National men raised $165,000 for this Society, and National women made hundreds of garments for it

YEAR 1918

144 subscriptions received in 1918-19 Christmas Drive......$ 14,766.15
(Part of these came in in January and February, 1919)
236 total new subscriptions raised up to Dec. 31st, 1918....129,639.93

These were distributed as follows:

About 6% were for soldier-godsons.
About 94% were for orphans.

SUM OF NELA FUND SUBSCRIPTION FOR TWO YEARS 1917–1918

Total number subscriptions.. 449
(For certain of these subscriptions, several subscribers clubbed together)
TOTAL AMOUNT SUBSCRIPTIONS.............................$146,562.43

IX. "CHILDREN OF THE FRONTIER"

The motives which impelled the National Lamp organization to proffer its services in financing the budget of the Society,"Children of the Frontier," for the year 1919 may be summed up in Mr. Terry's General Letter No. 1133, of August 21st, 1918.

"We have offered the services of our organization in raising the amount required by the Society, 'Children of the Frontier.'

"We have placed this work in charge of Mr. Boynton, who will assign parts of it to our different managers, and who, in turn, may further subdivide the work by assigning the smaller cities to their salesmen, office employees and others, reserving the large cities for themselves. In this way a great burden will not be placed on any one.

"But speaking of burdens, no one will be asked to undertake so great a task as is undertaken by every one of our soldiers. In winning the war it is necessary to use the united force of business organizations. Those in charge must select war work for such organizations to undertake. The war will not be won by our waiting for things to come to us.

"Mr. Boynton is preparing printed matter which will describe the work of the 'Children of the Frontier' and will show by endorsements the esteem in which the work is held.

"The work that the society,'Children of the Frontier,' is engaged in is not the same as the other French orphan work that I have been interested in. The Nela Fund work has been to provide the means of keeping children in their homes. For this work war contributions are obtained from individuals.

"The Society, 'Children of the Frontier,' takes French children who cannot be kept in their homes. Many are from the invaded districts and have been in the hands of the Germans. They are kept by the Society in large homes and are educated and trades taught them and everything else done necessary to make them future useful citizens of France. It is more an economic work than one of charity. Heretofore, most of the money has been raised by Mrs. Joseph Lindon Smith, the Field Secretary, and her method has been to give talks in the large cities, and in that way she obtained her contributions. The establishment of War Chests makes it impossible to obtain contributions in the large cities where the War Chests are located, and it is necessary, therefore, to obtain funds from the War Chests. There are already nearly five hundred of them and the burden of any one visiting all of them is too great. Then, too, the obtaining of funds from War Chests is a selling proposition and can best be handled by a business organization such as ours.

"War Chests are desirous of using their money where it will do the most good. I feel that we can perform a valuable service in bringing to their attention the work of the 'Children of the Frontier.' I have had an intimate acquaintance with this work extending over a period of more than a year and during that time have personally contributed toward the work. It was first called to my attention by Mr. C. A. Coffin, Chairman of the Board of Directors of the General Electric Company, and it has his highest endorsement.

"It has been endorsed by the Government of France, the American Red Cross, and many others. The more completely it is investigated, the more generously it will be supported.

F. S. TERRY."

The history of the Society for Protecting Frontier Children dates from August, 1914, when Mr. Frederic R. Coudert, an American lawyer who was in Paris when war broke out, gathered from the roadsides of invaded Alsace over two hundred homeless and hungry children. These he brought to Paris and provided with temporary shelter until provision could be made for permanent quarters.

Permanent quarters took the form of farms or "colonies" in Southern France, where these frightened and delicate waifs, usually underclothed, were given medical care and nursed back to health. The Red Cross provided the medical attention, volunteer workers instructed the children, and philanthropic persons and organizations subscribed the means of maintaining the colonies.

The growth of the society, "Children of the Frontier," is a tribute to the founder and the zealous efforts of those who gave abundantly of their time and support to the welfare of these unfortunate children. From a society of one colony it grew to an institution numbering 38 colonies, harboring, on January 1, 1919, nearly 1800 waifs. In the four and one-half years of its operation it had provided shelter and education for 2800 children from the frontier lines of Belgium, France and Alsace-Lorraine.

Plan of Campaign It was to assist in this enterprise that the "National," in August, 1918, offered its services in raising the annual budget, which for 1919 amounted to $300,000. To raise this sum quickly and efficiently, it was necessary to approach the various city and county war-chest committees, which at this late period of the war were rapidly displacing all local campaigns for war relief. The $300,000 quota amounted to $72 for each thousand population in the war-chest cities. This sum would provide for the maintenance and education of one child for a year.

Approaching the War Chest Committees To facilitate the work of the National Lamp men who had to approach the war chest committees, an illustrated booklet of information and endorsement, "Special Survey of the Society for Protecting Frontier Children," was published and distributed to all war chests with a letter of application for a definite appropriation. It was the part of those assigned to this work to attend the meeting of the committee and to insure that the society's needs were given due consideration.

Even though the war ended shortly after the "National" had taken over this important work and it was found increasingly difficult in many small cities to secure the appropriation requested, the campaign more than met its goal. A total of $164,904 was secured through war chests in 59 towns. This includes subscriptions received to July 10, 1919. Below are listed places from which financial assistance was forthcoming, with the amount of their contributions.

Cleveland, O	$ 30,000
Columbus, O	22,700
Syracuse, N. Y	20,000
Rochester, N. Y	12,000
Youngstown, O	10,000
Beaver Falls, Pa	7,200
Albany, N. Y	6,000
Cincinnati, O	5,000
Lynn, Mass	5,000
New Bedford, Mass	5,000
Indianapolis, Ind	3,600
Utica, N. Y	3,000
Buffalo, N. Y	2,500
Dayton, O	2,500
Toledo, O	2,500
Pittsfield, Mass	2,500
Brockton, Mass	2,000
Springfield, O	2,000
Akron, O	1,440
Newark, O	1,200
Tonawanda, N. Y	1,200
Colorado Springs, Colo	1,100
Amsterdam, N. Y	1,000
Auburn, N. Y	1,000
Rome, N. Y	1,000
Troy, N. Y	1,000
Warren, O	1,000
Virginia, Minn	720
Elmira, N. Y	600
Waltham, Mass	600
Ashtabula, O	500
Belvidere Patriots Association, Ill	$ 500
Corning, N. Y	500
Escanaba Co., Mich	500
Kenosha, Wis	500
Lancaster, O	500
Logan, Hocking Co., O	500
McKeesport, Pa	500
Newark, N. Y	500
Racine, Wis	500
Seneca Falls, N. Y	500
Westbrook, Me	500
Athens, O	400
Ilion, N. Y	350
Mechanicsville, N. Y	300
Troy, N. Y	300
Kirkland War Chest, Clinton, N. Y	250
Melrose, Mass	250
Cortland, N. Y	200
Lowville, N. Y	200
Sheboygan, Wis	200
Shortsville, N. Y	200
Springfield, Vt	200
Wellington, O	150
Williamsburg, O	150
Batavia, O	144
Clifton Springs, N. Y	100
Dover, O	100
Batavia, Ill	50
Total	$164,904

In securing the War Chest contributions for the "Children of the Frontier," direct expense to the amount of over $2,000 was incurred by the National organization.

To the above list should be added the following appropriations which the Society had for its 1919 operation.

Refugees Relief Fund	$ 12,000
Refugees Relief Fund (special)	5,000
National Allied Committee	5,000

Piping Rock Horse Show	7,000
Private Colonies	60,000
Adoption Fund	75,000
Refugees Relief Fund	5,000
	$169,000
War Chest Subscriptions	164,904
TOTAL	$333,904

In addition to the efforts given in securing financial aid for the "Children of the Frontier," employees of the National Lamp Works, under the supervision of Miss R. S. Streifender, donated considerable time to the making of garments for the "frontier children.' Reference to this activity is made on page 318. Expert personal assistance was also rendered the society by Mr. F. S. Terry, who aided in organizing its accounting in both New York and Paris.

X. "SOCKS FOR SOLDIERS"

(*See pages 307 to 310*)

17,347 pairs of first-class woolen socks, value during the war at least $4.00 per pair	$69,388

XI. FINANCIAL ASPECT OF RED CROSS WORKERS' ACTIVITY

This refers to the work done by the girls in the Red Cross Unit at 45th Street, Cleveland, and in the National plants in other cities, in making garments, surgical dressings, etc., for the Red Cross. The story of the work has been told on pages 311 to 323.

Estimated Value of Finished Supplies Made for Donation to Red Cross at 45th St., in 1917 and 1918	$192,000
Estimated Value of Similar Supplies made by employees in other National plants	90,000
TOTAL	$282,000

XII. FINANCIAL SUPPORT OF WAR GARDENING

Expense of Fencing, Plowing, Harrowing, Fertilizing, etc., for War Gardens in 1917 and 1918	$3,790.75

XIII. SUPPORT OF WAR ACTIVITIES (RESEARCH AND DEVELOPMENT) UNDERTAKEN BY HOME OFFICE LABORATORIES

This item, representing expense incurred by the National in connection with the activities described in Part II of this book, amounted to over	$ 82,000

XIV. MISCELLANEOUS CONTRIBUTIONS TOWARDS WINNING THE WAR

It is, of course, impractical to enumerate all of the many miscellaneous items of financial outgo in connection with the war activities. Among these miscellaneous items were the following:

Payment of four weeks' wages to employees of 6 months' standing, upon their entering military service.
Special watchmen, to safeguard war work being done in the Company's plants.
Overhead Expense of Liberty Loan and other Campaigns.
War Study Clubs (see page 301).
The above items, together with dozens of others of a miscellaneous nature, amounted to over $48,100

XV. SUMMARY

The following minimum totals, taken from the preceding pages of this Part, are here brought together in order to show at a glance just what "mobilizing our dollars" meant to the National Lamp Works and its people.

WAR INVESTMENTS

Liberty Bonds (excluding Victory Loan) and War Savings Stamps Purchased	$1,877,510.

WAR CONTRIBUTIONS

First Red Cross Drive	$ 17,618.82
1917 Red Cross Membership Campaign	6,000.00
1917 Y. M. C. A. Campaign	8,068.00
Miscellaneous Nation-Wide Relief Campaigns	3,858.85
War Chests	197,259.56
United War Work Campaign	17,463.65
Nela Fund—Subscriptions secured in 1917 and 1918	146,562.43
Children of the Frontier—Expense of Fund-Raising Campaign	2,000.00
Sock League—Value of Product	69,388.00
Red Cross Garments and Surgical Dressings, Value of	282,000.00
War Gardening—Expense of Installing and Operating	3,790.75
Support of War Research and Development at Home Office Laboratories	82,000.00
Miscellaneous Contributions towards Winning the War	48,100.00
TOTAL	$884.110,06

If, to the "War Contributions," we add the $1,877,510 of "War Investments," the total outpouring of money for war relief purposes, through the National Lamp Works, is seen to be *more than two and three-quarters millions of dollars.*

PART V

VARIED FORMS OF WAR SERVICE

War Gardens; Selective Service Board Work; Co-operation With Fuel, Food and Railroad Administrations; Other Activities.

VARIED FORMS OF WAR SERVICE

Our history of National Lamp Works' activities in the war would not be complete without some reference to the many miscellaneous forms of war service which cannot be classified under any of the preceding chapters. Among these hitherto unconsidered activities are the following:

War Gardens.
Selective-Service Board Work.
American Protective League.
Magazines, Books and Tobacco for Soldiers.
Co-operation with Food Administration Program.
Co-operation with Fuel and Railroad Administration.
Special Statistical Reports.
Publicity for War Causes.
Intensive Production of Lamps for War Industries.
War Exposition.

WAR GARDEN ACTIVITIES

"Our managers in charge of all vacant land belonging to the National will make arrangements to have it planted."

In so many words, on April 24, 1917, the management of the National Lamp Works summed up its conclusions in regard to the war garden activities which the National would undertake in harmony with the nation-wide movement to alleviate the food shortage in this country and in the countries of our allies.

It was fully understood that this undertaking would require the expenditure of a large amount of money, and that the money value of the product raised might not be appreciably greater than the expenditure, but it was realized that the question of dollars was not the vital one. As Mr. Terry expressed it, "It is not a case of cost or of difficulty—it is simply a question now of planting so as to produce the largest quantity of food of a kind that is likely to be needed."

War Gardening Starts in Many Cities

Under imperative instructions of this nature, war gardening went ahead as rapidly as possible. Four and six-tenths acres of ground at Nela, bounded by Nela Avenue, Kirk Street, Hillside Avenue and Nela Park, were plowed, harrowed, limed, and staked off into over one hundred gardens, each measuring 35 by 40 feet. These plots were soon assigned to the employees, men and women, who eagerly sought them. Paths provided easy access to any plot. A storehouse was erected in the center of the garden where tools, fertilizer, seeds, etc., could be kept ready for use.

National Divisions in other cities in various parts of the country, likewise utilized such space as was available; some who had no space of their own rented land for their employees. In all cases the expense of preparing the soil, of fencing in the garden, and, in some cases, of providing seed was borne by the National. So important was this work felt to be that seed for the home gardens of employees was also provided.

Responsibility for results was placed upon Mr. A. V. Simis, manager of the Service Department, who was assisted by Mr. J. R. Colville of the Engineering Department. The aim was to co-operate in every way with the gardeners to insure effective results. Many of the women, and not a few of the men, who undertook gardening had had no previous experience. Pamphlets, planting charts, talks by experienced gardeners, and consultation facilities were provided. Those gardeners who were familiar with the work co-operated with the inexperienced. Frequent inspection of the plots provided opportunity for personal suggestions. Letters were used to notify the gardeners when different crops could safely be planted. In this way, the gardens were kept working throughout the entire season.

Prizes for Best Gardens

The announcement that prizes would be awarded for the best plots stimulated gardeners and added interest to the work. By successive planting and a careful arrangement of crops, some of the 35-by-40-foot gardens produced in excess of fifty dollars worth of vegetables. Books on the canning and storage of vegetables were distributed to all of our "farmers" and "farmerettes." In most cases the benefits of the gardens lasted well into, or through, the winter season.

Although no attempt was made to obtain accurate records of the quantities of vegetables produced during the 1917 gardening season, the interest of the employees in the work, the care with which gardens were kept, the evident success of the scheme, and the insistent requests of the gardeners for next season's space, furnished ample justification for going ahead with the activity throughout the 1918 season. And in the 1918 season, the experience gained the year before, the good growing weather, and the better condition of the soil—which in addition to the natural improvement through being worked had been improved by a generous supply of fertilizer, combined to make really successful gardens. Accurate records of crops were kept, and these showed, what was hardly to be expected, a cash value considerably in excess of the cost.

1918 Gardens Show Good Profit

From the Nela garden alone were taken in the one season over a ton of green beans, nearly a ton of beets, more than a ton and one-half of cabbage, over a ton of carrots, 750 dozen ears of sweet corn, over 500 quarts of peas, close to half a ton of potatoes, over 6 tons of ripe tomatoes, 2 tons of green tomatoes, and many less important vegetables in large quantities. In every sense the 1918 season was a decided success.

From an historical standpoint, it is regrettable that accurate records were not kept of all the war gardens which the National operated. At the time, the importance of producing food completely overshadowed all thought of the value of records in the minds of the Divisions. For this reason it is impossible to give a report of the total amount of vegetables gathered. An idea of the results can be obtained, however, from the following record, which is for the Nela garden alone during the 1918 season:

Vegetables	*Quantity*
String Beans	2340 lbs.
Lima Beans	24 lbs. (Shelled)
Dry Beans	47 lbs.
Beets	1860 lbs.
Cabbage	3340 lbs.
Carrots	2120 lbs.
Cauliflower	28 heads
Celery	250 stalks
Swiss Chard	230 lbs.
Sweet Corn	750 dozen
Cucumbers	1150
Eggplant	40
Endive	90 heads
Kohl Rabi	70 lbs.

Vegetables	*Quantity*
Leaf Lettuce	210 lbs.
Head Lettuce	55 heads
Green Onions	280 bunches
Dry Onions	190 lbs.
Parsnips	150 lbs.
Peppers	930
Peas	560 quarts
Pickles	1100
Potatoes	865 lbs.
Pumpkins	44
Radishes	1600 bunches
Rutabagas	100 lbs.
Salsify	118 lbs.
Spinach	7 lbs.
Squash	117 lbs.
Ripe Tomatoes	12,300 lbs.
Green Tomatoes	4800 lbs.
Turnips	490 lbs.

Although the signing of the armistice reduced in some measure the importance of war gardening, and removed much of the stimulus that had made the hard work a pleasure, the interest of the employees in certain Divisions of the National was sufficient to cause the continuance of this activity in 1919 and 1920. Aside from the fact that food was produced when it was urgently needed, and aside from all considerations of the money value of the crops, there remained the element of healthy, enjoyable recreation, all of which conduced towards making the expenditure eminently worth while.

SELECTIVE SERVICE

The Legal Advisory Boards formed an important cog in the machinery of the Selective Service, or "draft." The United States was divided up into Selective Service districts, and in each of these districts there was a Selective Service Board, charged with the responsibility of examining the registered men and selecting those who should be inducted into military service. Each Selective Service Board was assisted by a "Legal Advisory Board," whose duty was to assist the registered men in properly filling out the very detailed questionnaires which they were required to turn in, and upon which their classification largely depended. The Advisory Boards were composed of men of high standing in their communities, who volunteered their services and

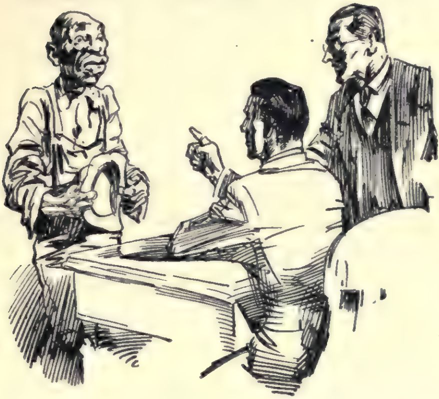
Bird's-Eye View of the Nela War Gardens

Close-up View of One of the Gardens. Looking towards Nela Avenue.

Protective Lighting at the East Forty-fifth Street Plant

How the Armistice was celebrated at Nela Park were granted the authority of administering the oath to the registrants. The "full members" of the Legal Advisory Boards were lawyers, but much of the work was done by "associate members" who were not members of the legal profession.

Dozens of men from the National Lamp Works patriotically contributed their services on the Legal Advisory Boards and spent evening after evening assisting registered men, of all shades and degrees of intelligence, in filling out the Government questionnaire. Many of the registrants could not read, write or speak English, and had to be interviewed through interpreters. One of the Board Members, from the National's Publicity Department, assisted a Southern negro who, upon being asked the question "Were you born in this country?" replied "Laws, no, sah—Ah wasn't bawn in this country—Ah was bawn in Tennessee!"



AMERICAN PROTECTIVE LEAGUE

The American Protective League was a volunteer organization which, in the words of Manager W. D. Frank of Nela Press, one of its members, "took an active part in following up slackers, pro-Germans, deserters and I. W. W. cranks." In Cleveland alone, the A. P. L. had a membership of about six hundred.

While we have no record of the total number of men from the National Lamp organization who worked with the A. P. L., the number was considerable, and some of the Divisions were particularly active in this work. J. F. Donovan, manager of the Equipment Development Department, was a member. The Federal Miniature Division, Chicago, furnished two members. The Buckeye Division furnished one—Harry E. Huff.

The record of the Bryan-Marsh Division, Chicago, may be noted in detail, as it was extensive. J. S. Corby, Sales Manager, was a captain in the A. P. L. when it was organized, upon the United States' entry into the war. Later, when the League was reorganized, Corby was promoted to the rank of Inspector No. 1, in charge of the Southwestern Division (Chicago District), and had command of 14 captains, 84 lieutenants and 700 men. A. H. Meyer, General Manager, was a lieutenant in the A. P. L., and later relieved Mr. Corby on his work as Inspector. A. B. Ewing and J. L. Barnard were both members, and Sam Furst was successively operative, lieutenant and captain.

MAGAZINES, BOOKS AND TOBACCO

About one thousand books were donated to soldiers and sailors through the National Service Department, as the result of a canvass of the employees at Nela Park. The Service Department also organized the sending of Christmas gifts to soldiers, four hundred Christmas packages being filled by National Lamp people in Cleveland in 1918 as a result of this activity.

Employees of the Statistical Department report sending thirty-two magazines to soldiers. This, of course, was a common practice among magazine subscribers during the war, and presumably hundreds of magazines were contributed by National people as a whole—although none but the Statistical Department went to the extent of recording their gifts statistically.

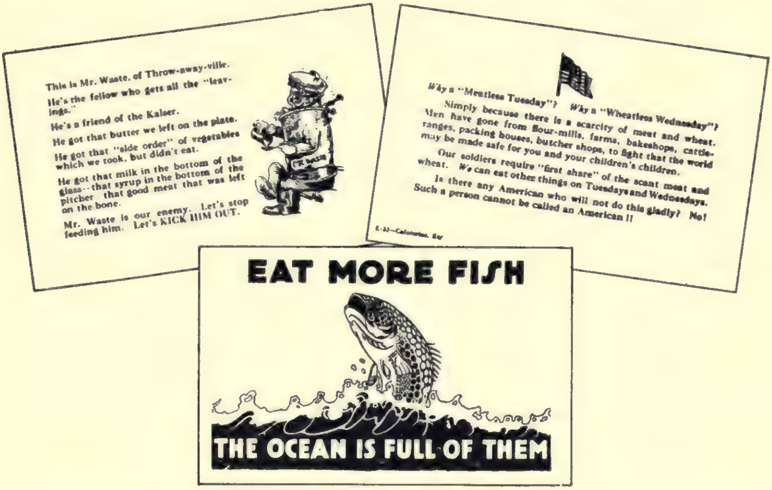
Men in the Commercial Development Department raised $75 for the Belgian Soldiers' Tobacco Fund; another "tobacco fund" collection, among the men of Rhode Island Glass Division, netted about one hundred dollars.

CO-OPERATION WITH FOOD ADMINISTRATION PROGRAM

"Food Will Win the War."

Everyone who was old enough to "know beans" in 1917 and 1918 remembers vividly the "meatless days" and "wheatless days" that the American people were asked to observe, in order to conserve food for our soldiers and allies. Herbert Hoover, as Food Administrator, secured voluntary pledges of co-operation from a large percentage of the housewives and restaurant proprietors of the country. As the war progressed, the food restrictions were of necessity rigidly and more rigidly enforced.

The National Lamp Works, because of the dozen or more dining-rooms operated in its various plants, might be said to be in the restaurant business on a wholesale scale. The dining-room at Nela Park and those in the other Lamp Works properties were duly enrolled as members of the U. S. Food Administration. Certificates of membership, and sets of Food Administration rules, were posted conspicuously in our cafeterias, and the "wheatless," "meatless" and "porkless" days were observed as requested.



This is Mr. Waste, of Throw-away-ville.

He's the fellow who gets all the "leavings."

He's a friend of the Kaiser.

He got that butter we left on the plate.

He got that "side order" of vegetables which we took, but didn't eat.

He got that milk in the bottom of the glass--that syrup in the bottom of the pitcher that good meat that was left on the bone.

Mr. Waste is our enemy. Let's stop feeding him. Let's KICK HIM OUT.

Why a "Meatless Tuesday"? *Why* a "Wheatless Wednesday"?

Simply because there is a scarcity of meat and wheat. Men have gone from flour-mills, farms, bakeshops, cattle-ranges, packing houses, butcher shops, to fight that the world may be made safe for you and your children's children.

Our soldiers require "first share" of the scant meat and wheat. *We* can eat other things on Tuesdays and Wednesdays.

Is there any American who will not do this gladly? No! Such a person cannot be called an American !!

EAT MORE FISH

THE OCEAN IS FULL OF THEM

Through the Goodwill Placard Service maintained by the Publicity Department, efforts were made to educate employees to the necessity for co-operating with the Food Administration in their own homes. A series of cards was designed, and displayed in card-stands on the cafeteria tables; a few of these cards are reproduced in the accompanying illustration.

CO-OPERATION WITH FUEL ADMINISTRATION AND RAILROAD ADMINISTRATION

Food, fuel and money—these were the three lines along which the greatest efforts at saving must be made in time of war. How the National helped save money and food has already been related. Fuel-saving, as will be manifest from the following paragraphs, also played a big part in our program.

The "Heatless Mondays" of the early spring of 1918, and the "Autoless Sundays" of the same year, were two long-to-be-remembered landmarks in the fuel-saving campaign. In order to conserve coal for bunkering our troop-ships as well as for other war purposes, it was forbidden, for several Mondays in succession, to heat business offices or factories except those engaged on the most urgent forms of munitions manufacture. This order of the Fuel Administration affected practically all of the National Lamp Works people, many of whom put in their time on "Heatless Mondays" in spading up their war-gardens.

The principal reason for having the "Autoless Sundays," on which automobile owners east of the Mississippi were requested not to drive their cars, was to save gasoline for airplanes. It was an odd experience to see the main thoroughfares of our cities, as for example Euclid Avenue in Cleveland, absolutely devoid of automobiles during some of the finest motoring weather. For a few Sundays, the time-honored "horse and buggy" enjoyed the popularity of a bygone generation. The order against automobile driving was more in the nature of a request than a law, but woe betide the motorist who transgressed! Not only did he invite public scorn, but he was quite likely to attract more tangible objects, such as tacks in his tires, and the well-aimed missiles of patriotic small boys.

Recognizing that millions of tons of fuel are burned in generating electricity for electric lighting, and that much fuel could be saved by cutting out wastefulness in electric illumination, a committee of men prominent in the electrical and incandescent lamp industries was appointed by the Fuel Administrator.

The purpose of this committee, of which Mr. John W. Lieb was chairman, and Messrs. J. M. Woodward and L. P. Sawyer of the National Lamp Works were two of the members, was to formulate a program whereby the lighting interests could so regulate their business as to co-operate with the Fuel Administration. Other executives from the National attended several of the committee's meetings.

PROGRAM OF FUEL CONSERVATION ADOPTED

The work of the committee just mentioned resulted in certain recommendations, which were given wide publicity as a war measure. Briefly stated, the recommendations were:

> (a) Use of carbon lamps to be discouraged, except where MAZDA lamps cannot be used to replace the carbon. Certain types of carbon lamps eliminated entirely. All orders for carbon lamps to be accompanied by signed statement showing that the purchaser fully understands the Fuel Administration's program.
>
> (b) No more GEM lamps to be consigned to agents' stocks. Central Stations to discontinue free renewals of GEM and carbon lamps.
>
> (c) The employment of single large MAZDA lamps rather than a number of smaller lamps of lower efficiency. (Larger lamps produce more light in proportion to the amount of coal consumed.)
>
> (d) Curtailment of all useless or wasteful lighting; lamps, when not in use, always to be turned off.
>
> (e) The use of MAZDA B lamps of 100 watts or larger is not recommended, MAZDA C lamps being more economical from the fuel standpoint.

The use of electric signs, outline lighting and outdoor ornamental and display lighting of all sorts was greatly curtailed during the latter part of the war. New York's "Great White Way" became only a "shadow" of its former self. Don H. Wyre, Chicago manager for the Buckeye Electric Division, was connected with the U. S. Fuel Administration in Chicago and, during part of 1918, gave two hours a day to the supervision of the "Lightless Night" order.

Ward Harrison, Engineering Department, was appointed a member of the Central Committee for Northeastern Ohio of the Conservation Division, U. S. Fuel Administration, as Supervising Engineer of Conservation for Mahoning and Trumbull Counties. He personally inspected a large number of the industrial plants in this district.

H. T. Spaulding, another of our engineers, served on a sub-committee which made a report to the Fuel Administration on Electric Lighting of Coal Mines to Accelerate Production.

PRIORITY CERTIFICATES

The demand for raw material for war purposes became so great that the Government issued regulations enumerating a large list of materials which were to be used for essential purposes only, the "essential purposes" including the direct and indirect war needs of the Government and work of national or exceptional importance, and an elaborate system was established whereby each industry had to make its application for place on the Preference List. Based on the showing made in its application, each industry was given a classification stating the comparative order in which its requirements of raw materials would be supplied. The incandescent lamp industry was placed on this Preference List, but in the lowest class, and when the automatic priority to which the lamp industry was entitled, as shown by that list, was not sufficient to enable us to obtain our needed supplies, it was necessary to file individual priority application to obtain specific permission to purchase a given quantity of the material in question. Our Law Department and Purchasing Department filed a large number of these applications for the National and Edison Lamp Works, as well as for outside companies, such as the Corning Glass Works, Buckeye Clay Pot Company and others, upon whom we were dependent for essential material. While there were times of stress, when it seemed that our supply of certain raw materials would be exhausted before new supplies were obtained, there was no case in which any of our factories had to close through failure to obtain raw materials.

The brass situation became more acute as the war progressed. Brass is the principal material used in lamp bases. For a long time we were obtaining our supplies only on individual priority applications, followed by a special permit which had to be obtained on top of the priority certificate. Later on we were called upon to curtail our use of brass by using substitute materials, which were less needed for war purposes. We thereupon made elaborate plans for "turning old bases into new"—that is to say, collecting the bases from old burned-out lamps and making them over into new bases. The aid of school-children, Boy Scouts, Red Cross depots and other agencies would no doubt have been necessary in order to have collected enough old bases to make this plan feasible. The signing of the armistice came just in time to make it unnecessary to carry out our base-reclaiming program.

In addition to obtaining raw materials for lamp-making, through priority certificates, it devolved upon the Law Department to request necessary transportation facilities from the U. S. Railroad Administration, through the medium of special permits.

SPECIAL STATISTICAL REPORTS

As a means of mobilizing and conserving the country's resources for war purposes, the Government required a mass of reports dealing with raw materials, labor, manufacturing facilities, etc. At first the Law Department undertook to prepare these reports, but shortly surrendered the work to the Statistical Department, which being well equipped for it, rendered very prompt and efficient service. Reports were prepared by our Statistical Department for the Edison Lamp Works as well as for the National; assistance was also given to the Westinghouse Lamp Company and to the manufacturers of Franklin lamps in the preparation of their reports. Among the many reports requested and supplied were:

American Registration Card.
Conservation of Paper and Printers' Supplies.
Glass Committee Elected to Represent Glass Manufacturing Industry in Relations with Government.
Bid for Furnishing Supplies to Medical Department, U. S. Army.
Report of Fuel Conditions, Cleveland, Ohio.
Molybdenum Concentrates Report.
Malleable Tungsten Report.
Labor Requirements, Cleveland, Ohio.
Report on Tungsten Ore.
Report on Molybdenum Ore.
Monthly Report to Priorities Committee, War Industries Board.
Tungsten Consumption Report for War Industries Board.
Tungsten Consumption Report for Bureau of Mines, Department of the Interior.

PUBLICITY FOR WAR CAUSES

The large amount of work done by the Publicity Department, Nela Park, in promoting the various money-raising and relief campaigns, has been referred to in Parts III and IV. It is worth mentioning at this point, however, that our publicity efforts for war causes were not confined to specific campaigns. Articles of a patriotic nature were published at frequent intervals in the *National Mazda Stimulator* (our monthly magazine for lamp agents), and by the National Service Department in the *National Lamp News* (the magazine for our own employees).

Both magazines, for example, published an article on stamping out venereal disease, at the suggestion of the Social

Hygiene Division of the War Department Commission on Training Camp Activities.

150,000 copies of the *Stimulator*, as they went through the mails at the rate of 15,000 copies per month in 1918, featured the following slogan in large type on the outside of each envelope: "THE FIRST BUSINESS OF EVERY BUSINESS MAN IS TO HELP WIN THIS WAR." The libraries of a great many military training camps were placed on the *Stimulator* mailing list.

Two large Honor Rolls, giving the names of National Lamp men and women in Government service, were published by the *Stimulator*.

In November, 1918, in accordance with a request of the Paper and Pulp Section, War Industries Board, complete arrangements were made by the *Stimulator* for cutting down its paper requirements by 25% for the ensuing year, and a voluntary pledge was signed to that effect.

Hundreds of thousands of sheets of regular correspondence stationery of the National Lamp Works were imprinted with slogans boosting various patriotic drives.

PROTECTIVE LIGHTING

Not only did the National Lamp Works thoroughly equip the exteriors of its own buildings, where advisable, with Protective Lighting systems, in order to guard against sabotists, but its engineers also developed the entire subject of Protective Lighting for buildings, bridges, etc., very thoroughly. A 50-page manuscript, prepared largely by Mr. Magdsick of the Engineering Department, was published early in 1918 by the War Department as Document No. 800 and was distributed by the Divisional Militia and the Military Intelligence.

An illustrated lecture on Protective Lighting was worked up for the Illuminating Engineering Society and was used on a number of occasions by Mr. Edmund Leigh, Chief of Plant Protection, Section of Military Intelligence, United States Government.

LIGHTING TO ADVERTISE FINANCIAL DRIVES

The Cleveland Liberty Loan Committee placed upon the Illuminating Engineering Section of our Engineering Department the responsibility for all lighting equipment, arrangements and stunts in connection with the several Loan campaigns. Similar demands were met in the War Chest Campaign and the Allied War Exposition. With the co-operation of Mr. Hanley of the Cleveland General Electric Office, three 500,000,000 candlepower searchlights were secured for the Fourth Liberty Loan. These were mounted on high buildings, where they could sweep over a wide area. The Liberty Loan Publicity Committee asserted that these searchlights were talked of the most of any of their attractions.

Lighting of Workmen's Cottages

Mr. E. J. Edwards was chairman of the sub-committee on Lighting of Workmen's Cottages of the I. E. S., and discussed this subject before a meeting of the War Industries Board at Washington.

Intensive Production of Lamps for War Industries

The *G. E. Review*, in its issue of October, 1919, pays the following tribute to the efforts of the incandescent lamp factories in maintaining essential production throughout the war period:

"Of course all of the Company's Lamp Works were busy turning out their standard products as well as helping wherever they could by doing special work for war purposes. In fact, this is a most striking example of how the Company's manufacturing activities were all the time helping others to do their bit. During the first nine months of 1918 they made 103,000,000 incandescent lamps of the larger sizes. If we include all sizes the production of these nine months amounts to 148,000,000 lamps. Who can estimate what this contribution did toward helping the whole country speed up its war work? The Company was employing more than 16,000 people in helping to light the work shops, offices, camps, homes, etc., of America during all this period."

The foregoing statements apply with equal force to the efforts of our Ivanhoe Division in maintaining essential reflector production and distribution during the war. Thousands of marine globes were supplied for use on battleships and other ships; thousands of steel and glass reflectors were furnished for cantonments in the United States, and for the American Expeditionary Forces.

WAR EXPOSITION

In November, 1918, a great War Exposition was held on the lake front and in Central Armory, Cleveland. One of its objects was to bring the war cause more strongly to the attention of industrial workers, thus stimulating production of war material. The signing of the armistice converted the War Exposition into a Victory Exposition, and as such it was indeed successful, over 575,000 people attending. The National Publicity Department had charge of the feature advertising of the Exposition. The National management purchased several thousand tickets, presenting one to every employee who wished to attend.

Our tale is now ended. The story of Nela's part in the greatest military convulsion of all time has been told—so far as the mere printed record can tell it. With a new spirit of co-operation among the nations—with that spirit of harmony which we have always stood for in business—we pray and believe that similar sacrifices, a similar outpouring of human life and blood, will never again be required. But whether the destructive work of war, or the constructive work of peace, shall be the future great need of our country, the National stands ready, as in 1917-'18, to do its best.

The Glory of War

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